### **APPENDIX A**

## INITIAL ASSESSMENT OF LONG TERM STEWARDSHIP SCIENCE AND TECHNOLOGY NEEDS

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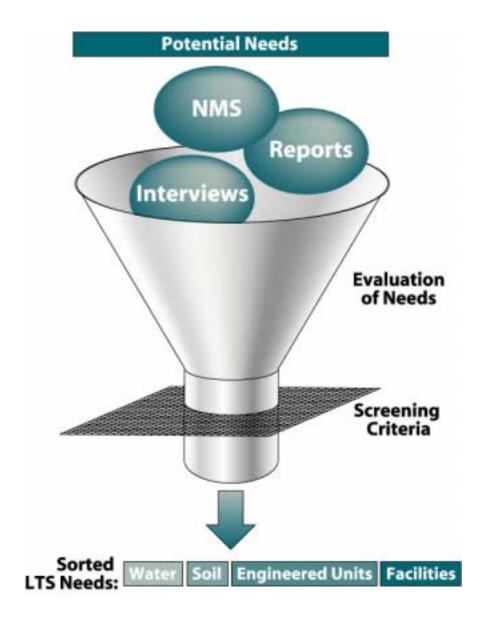
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# APPENDIX A INITIAL ASSESSMENT OF LONG TERM STEWARDSHIP SCIENCE AND TECHNOLOGY NEEDS

#### I. Initial Assessment Methodology

# A. Initial Assessment of Long-Term Stewardship Science and Technology Needs

The process of identifying long-term stewardship (LTS) science and technology (S&T) needs involved (a) determining what sources of potential needs were available (e.g., reports, interviews); (b) developing a methodology, screening criteria, and an electronic database for use as tools to help identify or evaluate those sources; (c) collecting the potential needs from those sources; (d) using the screening methodology to narrow all potential needs to only those that met our criteria for LTS S&T needs; (e) using information entered into the screening database for categorizing and sorting the needs that met the criteria; and (f) evaluating the sorted and categorized needs and summarizing them into this initial needs assessment, which will be used as the basis for the Phase II needs assessment process. Figure 1 is a graphic depiction of the screening methodology, and Figure 2 shows the process flow for developing this long-term stewardship needs assessment. The ultimate objective of this effort is to use the needs assessment information to prepare a "roadmap" as part of the EM R&D investment strategy to improve the reliability and effectiveness of future long term stewardship activities.



**Figure 1. Screening Process** 

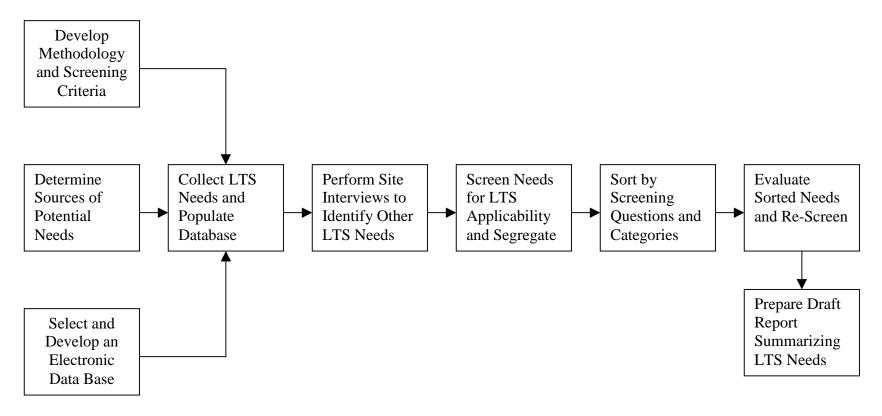


Figure 2. Long Term Stewardship Needs Assessment Process Flowchart

#### **B.** Existing DOE Sources of Potential LTS Needs Information

Numerous processes and documents have been employed within DOE to identify, prioritize, and track needs for research or technology to solve critical EM problems. These processes and documents have used DOE site operations, environmental restoration and waste management, and research personnel, along with regulators and stakeholders in some cases, to define where needs exist for technology development. The needs identified by these groups are found in documents and databases such as:

- EM Needs Management System (NMS),
- Individual Site Technology Coordination Group (STCG) databases,
- Environmental Management Science Program (EMSP) Management Plan,
- Integrated Planning, Accountability, and Budgeting System (IPABS),
- EM R&D Multi-year Program Plan (MYPP),
- EM Disposition Maps,
- Focus Area MYPPs,
- Focus Area Program Management Plans,
- Other EM Program Management Plans,
- DOE's Environmental Quality R&D Portfolio,
- Environmental Management Advisory Board (EMAB) reports, and
- The Characterization, Monitoring, and Sensor Technology (CMST) portfolio.

The needs data are used by EM-50 Focus Area personnel and others in prioritizing and funding specific projects.

A review of these sources led to the conclusion that the best single source for evaluating existing S&T needs specific to DOE sites for this initial assessment is the EM

Needs Management System. The NMS is a database (now part of the Technology Management System that can be accessed on the Internet at <a href="http://tms.em.doe.gov">http://tms.em.doe.gov</a>) maintained at DOE Headquarters. This database is a summary of needs and their descriptions prepared by the individual facilities' Site Technology Coordination Groups. Individual site or field office STCG databases contain more detail than is found in the NMS, and those STCG Internet web pages were reviewed when the information in the Headquarters-level NMS database was too brief and not sufficient for purposes of this analysis. While the NMS is a good, comprehensive tool that lists currently identified S&T needs (there are 810 needs in the FY 2000 database), it has limitations regarding long-term stewardship applications. The NMS was not originally designed or intended to identify longterm stewardship needs. The individual "problem holders" and STCG personnel, who developed the needs in the NMS, did not develop them with LTS as the focus; therefore, they were more focused on identifying nearer-term needs related to environmental restoration or waste management activities for assessment and funding prioritization. Nevertheless, the NMS is still a good source of S&T needs and was a major source of needs information which was screened and evaluated.

#### C. Reports as a Source of Potential LTS Needs

Another good source of information for S&T needs is published or draft reports. The EM-51 LTS Internet web site (<a href="http://lts.apps.em.doe.gov">http://lts.apps.em.doe.gov</a>) has a list of reference material related to long-term stewardship issues. Many of these reports are related to management or policy issues, but they were also reviewed to identify potential LTS S&T needs. Reports prepared by groups that have evaluated DOE research programs, such as the National Research Council of the National Academy of Sciences or the Keystone Center, were also

reviewed. While a number of these publications identify areas in which DOE research efforts may be insufficient, none of the reports was specifically meant to identify research needs with long-term stewardship applications. However, S&T needs with potential stewardship implications were identified from these reports as part of the screening and evaluation process.

The draft NDAA Report to Congress on Long-Term Stewardship at DOE Sites describes planned stewardship activities at DOE facilities. The report is organized with one chapter per state, and a few of these chapters provide a summary level discussion of needs for technology development that could improve reliability or reduce costs of planned stewardship. This report was also used as a source.

The reports which contained needs that were identified as long-term stewardship through our screening process include:

- Managing Data for Long-Term Stewardship, Working Draft Report, ICF Kaiser Consulting Group, March 1998.
- 2. Research Needs in Subsurface Science, National Research Council of the National Academies of Science, March 2000.
- 3. DOE Complex-Wide Vadose Zone Science and Technology Roadmap: Characterization,
  Modeling, and Simulation of Subsurface Contaminant Fate and Transport, Vadose Zone
  Science Integration and Technical Basis (Draft), INEEL/EXT-2000-00112, May 2000.
- 4. National Defense Authorization Act (NDAA) Long-Term Stewardship Report (Draft), DOE, June 2000.

 Environmental Management Science Program, Sensors Initiative for Identification of Long-Term Stewardship Research Needs (Working Draft), Workshop Held in Idaho Falls, ID, June 19& 20, 2000.

#### D. Potential LTS Needs from Interviews with Site Operations Personnel

The third category of source information for potential LTS S&T needs (in addition to the NMS and reports) was interview information from DOE site personnel. Interviews were conducted to obtain input from operational organizations that will be responsible for carrying out stewardship activities. Original plans included interviews at INEEL (a large continuing mission site), the Grand Junction Project Office (which has responsibility for long term surveillance and maintenance at a number of sites around the country), Weldon Spring (where most of the remediation has been completed), and other sites that are scheduled to begin stewardship in 2006 (Fernald Environmental Management Project, Rocky Flats Environmental Technology Site, and Sandia National Laboratories). However, schedule and resource considerations limited the number of sites that could be visited, and the actual visits were narrowed to INEEL, GJPO, and Weldon Spring. Although no onsite interview was conducted at Fernald, information regarding current NMS needs and future stewardshiprelated needs was also obtained from that site by telephone and other communications. A memorandum resulting from the Fernald discussions was used as a source of needs. One other internal memorandum that summarized a discussion between INEEL and EM-51 personnel was also a source document. Science and Technology needs resulting from these interviews were screened, using the same criteria as the NMS needs and those needs identified from reports, to determine which ones had long-term stewardship implications.

Prior to conducting interviews, a set of assumptions and questions to be used during the interviews was prepared. The purpose of the questions was to set the framework for the discussion and to try to get participants to think "long term" rather than about relatively short-term milestones that normally drive project activities. The key assumptions were that cleanup or stabilization had been completed, the end state was achieved, and the interviewee(s) was now responsible for long-term stewardship. The questions were intended to identify information such as

- What hazards or contamination would remain?
- What would need to be monitored or maintained to continue to ensure that human health and the environment were being protected?
- What are the significant regulatory, risk, and cost elements of anticipated stewardship activities?
- How could advances in S&T improve the reliability or reduce the costs of stewardship?

The set of draft questions was reviewed by several people representing a variety of expertise and backgrounds (e.g., ER, field operations, risk assessment) prior to conducting the initial interviews. The questions were revised, based on comments received and on the experience of the first few interviews for which they were used. The final set of assumptions and questions used for most of the interviews is found in the Glossary of Appendix A.

Since the INEEL is a large, complex site with a variety of facilities, programs, and environmental legacy problems, needs identified at the INEEL should be representative of those for many sites in the DOE complex. Twelve separate interviews were conducted with operations-oriented groups at the INEEL during a three-week period. The total number of 29

personnel were interviewed from these groups that included those responsible for operations at several diverse Environmental Restoration projects. These were:

- Waste Area Group (WAG) 1 at Test Area North where there are closed underground tanks and wells, and groundwater plumes with organic and radionuclide contamination;
- WAG 3 at the Idaho Nuclear Technology and Engineering Center, a facility that previously processed nuclear fuel and has soil and groundwater contamination (chemicals and radionuclide) areas that are being remediated,
- WAG 7 at the Radioactive Waste Management Complex where there is buried transuranic and low level waste in pits and trenches, and
- WAG 10 that is responsible for sitewide soil and groundwater remediation and monitoring activities not covered by other WAGs.

In addition to these environmental restoration projects, representatives of the following groups or programs were also interviewed:

- High Level Waste Program
- Spent Nuclear Fuel programs (both INEEL and National SNF program)
- Transuranic and Low Level Waste programs
- Deactivation, Decontamination and Decommissioning
- A proposed Facility Entombment Demonstration program
- Mixed Waste Focus Area
- Nuclear Materials Focus Area
- INEEL Tank Closure/Voluntary Consent Order program.

The purpose of interviewing such a broad spectrum of operations oriented groups was to try to capture needs of "end user" or "problem holder" organizations, rather than just the views of those with research interests. A representative of the Grand Junction Project Office assisted in about half of the interviews at the INEEL. The INEEL STCG also participated in each of the INEEL interviews because of the STCG role in working with end users to define and track potential needs.

Their responsibility is for long term surveillance and maintenance at a number of remediated sites around the country (many of them engineered disposal cells containing uranium mill tailings) and other sites that are currently in various stages of cleanup (e.g., facilities currently in the Formerly Utilized Sites Remedial Action Program) that will also be transferred to GJPO for stewardship. GJPO personnel have a current, operational perspective of long-term stewardship activities and future needs that added great value to the needs assessment process.

The third site interview was conducted at the Weldon Spring Site Remedial Action Project near St. Louis, Missouri. This site was selected because it is a site where most of the remediation has been completed, a large engineered disposal cell is approaching completion, and plans for long-term stewardship are being prepared. The cap over the disposal cell will be completed in 2002, and responsibility for long-term stewardship (surveillance, maintenance and monitoring) will be transferred to GJPO in FY 2003. Because they are moving rapidly toward stewardship activities, DOE and contractor personnel at WSSRAP were also able to provide an operational perspective regarding long-term stewardship needs. In addition to INEEL personnel, a GJPO representative also participated in this site visit to

better understand the current project status and stewardship plans. Anticipated stewardship activities at many sites will involve monitoring of subsurface contamination, and many currently identified needs are related to subsurface contamination. Thus, the Subsurface Contamination Focus Area (SCFA) has a continuing interest in needs identified for LTS and provided a representative for this interview as well. EM-51 participation in the site visit was provided by a representative from an EM-51 support contractor who has been involved in preparation of the LTS reports, including the NDAA Report and the Long-Term Stewardship Study for PEIS Settlement Agreement.

#### E. Methodology for Screening Potential LTS Needs

Some sites, STCGs and/or Focus Areas have reviewed the needs contained in the NMS to determine which ones were related to long-term stewardship, and therefore, a word search of the NMS database yields a set of needs that are labeled as "long-term stewardship." Unfortunately, the approach to this labeling exercise was not the same from site-to-site. To provide some consistency, the INEEL team developed a set of screening questions or criteria to be used to review each of the 810 needs in NMS. This process, using one set of questions and the same set of reviewers, resulted in a more consistent identification of LTS S&T needs from the existing NMS set. Once developed, the same set of criteria was used to screen and categorize potential LTS needs found in reports or obtained during site interviews.

The first step in this process was to develop a set of questions about a potential need to determine a relationship to long-term stewardship (i.e., if it is a need related to an activity required to protect human health and the environment from hazards remaining after cleanup is complete). As with the interview questions discussed earlier, the initial draft screening questions were developed and reviewed by the INEEL LTS S&T team, refined, and then sent

to others outside of the team for review and comment. These key questions and comments were then incorporated into an initial set of screening criteria. The screening criteria were entered into an Access database so that a uniform, documented process of evaluating needs and tracking results was used.

As a "field test" of the process and criteria, the 137 needs in the INEEL STCG database were screened. A meeting was held on June 6, 2000, at INEEL to explain the process, discuss results (i.e., which needs had been labeled as related to long-term stewardship), and solicit comments on the process. End user groups represented at this meeting included environmental restoration (WAGs and technology development personnel), the MWFA, NMFA, HLW program, STCG, and EMSP. Many useful comments and suggestions were received, and the screening criteria and database were modified accordingly. The final set of screening criteria and clarifying definitions is in the Glossary of Appendix A.

The actual screening was conducted by an interdisciplinary technical working group to foster discussion and reach consensus as the screening criteria were applied to each potential need. The results (positively answered questions) were captured in the database to allow further sorting, evaluation, and display. (See the screening matrix in Attachment A of this appendix.)

#### F. Discussion of Screening Criteria and Methodology

The first screening question is really a "go/no-go" criterion to determine if the need was related to post cleanup (an LTS activity). For the purposes of this initial need assessment screening exercise, the decision was made to identify only S&T needs that are related to post-cleanup activities. So, the first question is: "Is it or does it ensure or

demonstrate protection of human health or the environment after cleanup, disposal, or stabilization is completed?"

There are many legitimate S&T needs that have long-term implications, or needs that if addressed, would have long-lasting impacts. Needs related to making waste forms more robust are examples of needs with long lasting impacts yet were not included. For the purposes of this assessment, if the need is primarily critical to the cleanup mission (e.g., related to characterization or treatment), then it was not considered an LTS S&T need. Also excluded from this initial needs assessment were LTS needs associated with waste repositories, such as the Waste Isolation Pilot Plant for transuranic waste and Yucca Mountain for spent nuclear fuel. These facilities will have a set of needs specifically related to their operations and locations. A comment "box" was added to the database to identify those needs determined not to meet the first criterion but that nevertheless had LTS implications.

Some science needs are related to better understanding of fate and transport of contaminants and have long-term implications, even though the need is primarily focused on improving knowledge necessary to make a better remedy selection. There is a broad suite of subsurface science needs that fit this description. These needs were categorized, as LTS in this initial needs assessment because they represent such an extensive set of comprehensive needs that are applicable to many DOE cleanup decisions and follow-on activities.

If a need passed the first screening question, then a number of other questions (which are not prioritized or weighted for importance at this stage) were asked to help further understand and categorize the needs. For example:

• Is it or does it pertain to site maintenance?

- Does it relate to better understanding of the final engineered system performance?
- Does it contribute to a greater understanding of fate and transport of contaminants?
- Does it improve data management?
- Does it enhance the overall confidence in projected risk estimates?

A number of needs were identified that truly are LTS needs, but were determined not to be primarily science and technology related needs. Examples include: how to ensure funding of stewardship for very long periods, issues of intergenerational equity, possible needs for regulatory changes, etc. A question and category of "non S&T needs" was included to be able to track these needs.

After this set of questions was addressed, each need (except non S&T needs) was further categorized to determine if it was related to:

- Waste Form/Physical Barriers
- Data Collection/Transmission
- Information Management
- Environmental Setting and System Performance, or
- Crosscutting Issues.

Within each of these five categories, additional attributes were identified to assist in analyzing needs. For example, for needs dealing with Information Management, each need was further evaluated for the attributes of Data Analysis, Data Interpretation, Reporting, Accessibility, Retention, Records Management, and Cost of Records Management. Each attribute that applied received a "check" in the database.

Finally, after a need was placed into one or more of the five categories above, it was determined which contaminated site type or media (water, soil, engineered units, or facilities – see definitions in Introduction section) applied to that need. In some cases (e.g., the Information Management needs), a need could be applicable to more than one type of contaminated site.

For each of the 152 needs that were identified as valid needs from the LTS screening process, a "plain language" description was written to provide a non-technical description for easier understanding and clarity since many of the need titles are very technical and written specifically to be read by individuals having expertise in a particular field.

Entering the needs in the database in this manner provided a useful tool for examining the needs in a number of ways. By answering each question, then assigning the needs to different categories, identifying attributes of each need within the categories, and determining to which media the need was applicable, we were able to rigorously examine the results by querying the database and sorting LTS S&T needs in several ways. For example, we could determine how many needs fit into each of the four media or contaminated site types (soil, water, engineered units, facilities), or how many needs are related to surveillance and maintenance. More complex questions can also be asked. For example, how many needs are related to better confidence in risk prediction and involve contaminant modeling. Obviously, the number of multiple-attribute queries that can be done is quite large (although many would be meaningless).

After the original database was populated and queried, it was determined that there were other ways that the LTS S&T needs could be categorized. The set of 152 included needs was re-evaluated (re-screened) by examining both the title (as found in NMS, a report,

or from an interview) and the "plain language" definition and considering the "checked" categories and attributes for each need. From this "manual" evaluation, the needs were determined to naturally cluster into 8 general categories that provided another means of analyzing and segregating the data. These were:

- Subsurface Science
- Surveillance and Monitoring
- Caps and Covers
- Information Management
- Physical Barriers
- Ecosystem Monitoring
- Toxicity
- Non Science and Technology

These categories resulting from the second screening were used for the more detailed analysis and conclusions that are presented in this report.

#### II. Results and Analysis

#### A. Overview

The first step in the needs assessment process is determining what sources contain long term stewardship needs information. As stated in the "Initial Assessment Methodology" section of this Appendix, the primary sources of needs information were the DOE-EM Needs Management System (NMS), published reports, memoranda, and selected site interviews. Of the total 917 potential needs identified from these four sources, 810 were obtained from the NMS and 107 came from reports, interviews, and memoranda. Of the 917 needs that were screened, 152 were labeled as LTS. Eighty-one of those needs were from NMS, 29 were from interviews, 22 were from reports, and 20 were from memoranda (Figure 3). Of the 152 that were determined to have direct long-term stewardship applicability, 13 were classified as "non-S&T."

Another 130 needs were not included in the LTS needs list because they were more closely related to remediation, treatment, or operations; however, it was determined that satisfying these needs would have "long-term stewardship implications." An example of this would be: ods-rep-8-tn-1.2, "Extend the Life of Caps and Covers," which is an operational need that would enhance long-term system performance. As a result, these 130 needs were segregated and tracked separately in the database for future use.

In summary, upon completion of the initial needs assessment process, 152 needs were labeled as LTS, 130 were not included, but have LTS implications, and 635 needs were excluded from further review and consideration.

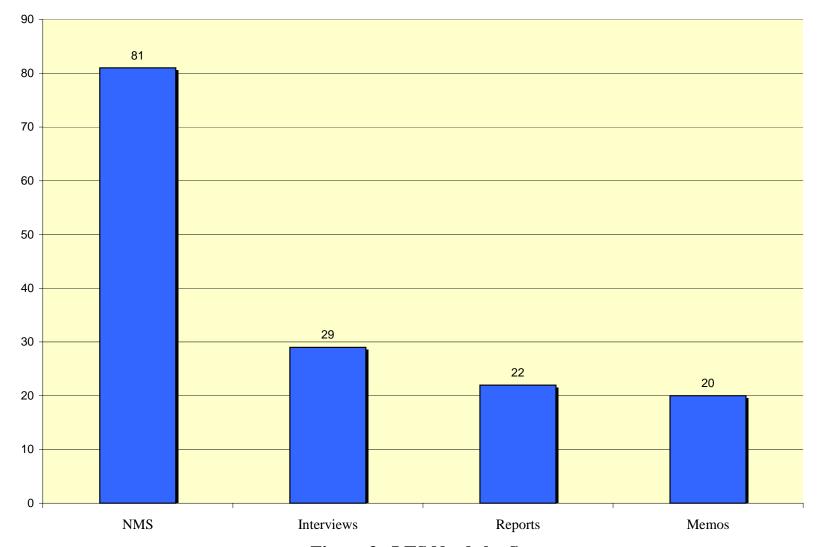


Figure 3. LTS Needs by Source

The LTS needs were also segregated by site, resulting in the distribution depicted in Figure 4. The field offices with the majority of included LTS needs were Idaho (46), Richland (33), Ohio (16), and Albuquerque (14), representing more than 70% of the total included needs. It should be noted that the large number of needs associated with Idaho is a reflection of the fact that 12 separate group interviews were conducted at the INEEL. Half of the needs associated with INEEL came from those interviews (labeled in the database as ods-int-id-x-x or Other Data Sources – Interviews –Idaho). Six more resulted from an internal memorandum representing discussion between INEEL and EM-51 personnel (labeled as ods-memo-id-x.x). Similarly, 14 of those from Ohio came from a memorandum resulting from discussions with Fernald personnel (identified as ods-memo-oh-x.x in the database) specifically aimed at identifying potential LTS needs. It should also be noted that many of the needs identified in this manner are not well developed at this time, but represent ideas from interviewed personnel as to what is likely to be needed or would be desirable. More detailed analysis is provided in subsequent sections of this report.

The 152 included LTS needs are also displayed in Figure 5 by the five *screening categories*: Waste Forms/Physical Barriers, Data Collection, Information Management, Environmental Setting, and Cross Cutting needs. The largest number of needs are associated with better understanding of the *environmental setting* (i.e., modeling, model validation, fate and transport, toxicity, uncertainty analysis, subsurface issues). Further analysis of the needs according to each of the screening categories is provided in Section II J.

#### **B.** Site Maintenance Analysis

The needs assessment process asked a series of eight screening questions. The purpose of these questions was to further refine and understand the identified need.

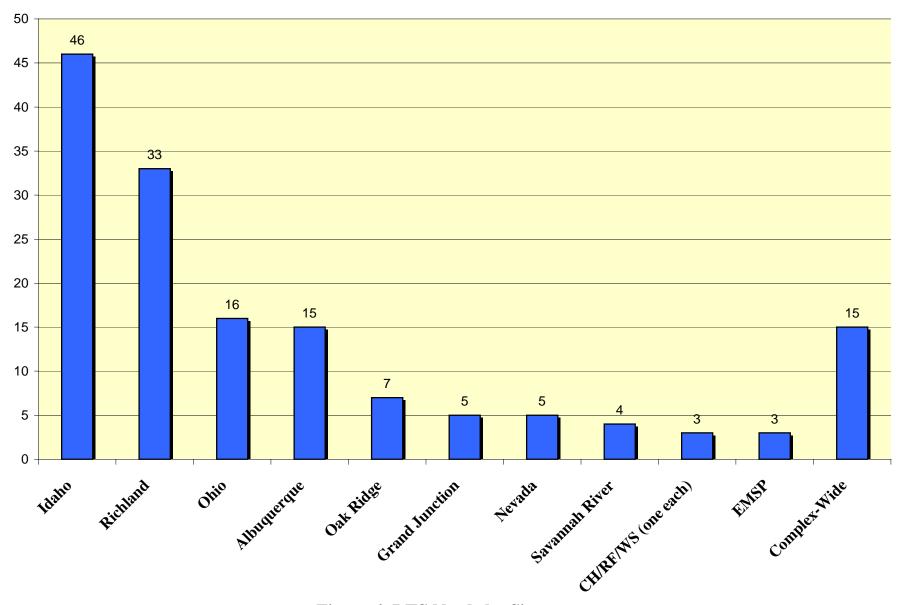


Figure 4. LTS Needs by Site

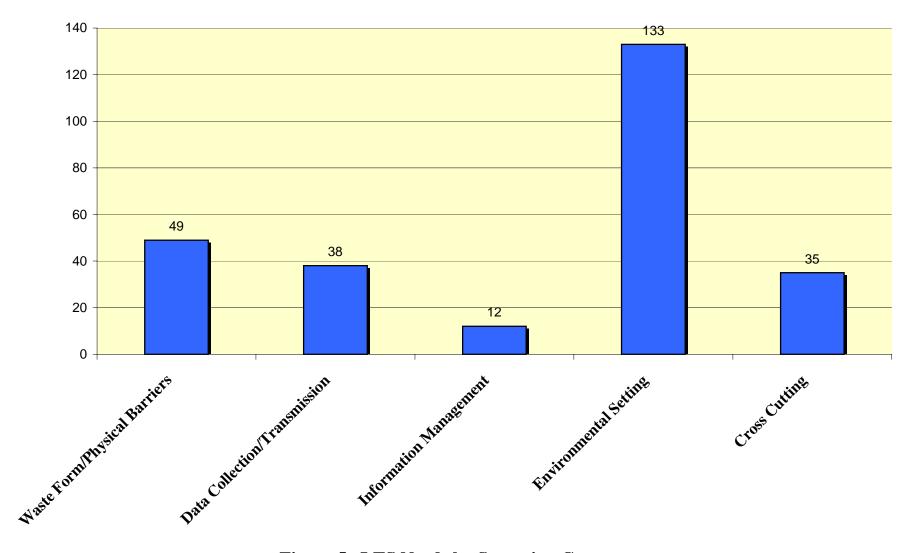


Figure 5. LTS Needs by Screening Category

Question 1 was "Does this need pertain to site maintenance?" In this case site maintenance is defined as those long-term stewardship activities that are strictly routine in nature. That is, they are expected and planned for. These activities include maintenance of both the environmental setting (e.g., noxious weed control) as well as any manmade structures (cap subsidence repair). As a result of this query it was determined that 23 of the 152 LTS needs pertain to site maintenance. Nine of these needs originated from the Ohio Field Office, 5 from the Grand Junction Project Office, 3 from the Idaho Field Office, 2 from the Oak Ridge Field Office, 1 from the Albuquerque Field Office, and 3 needs that were not site-specific. Nine of the needs came from memoranda, eight came from interviews with the remaining 6 found in reports.

A summary look at these 23 needs indicates considerable overlap with the surveillance and monitoring category. This is not unexpected. As an example, need odsmemo-oh-1.7, *Disposal Facility Physical Change Monitoring System*, expresses a need for a technology to measure physical changes and subsidence in disposal facilities. This information is critical to the site maintenance function. Other needs were related to leachate collection systems for buried waste sites and the need for improved physical barriers to deter intrusion.

#### C. Final Engineered System Performance Analysis

It is clear that a large percentage of the DOE sites that will require long-term stewardship will have some kind of engineered unit as part of their remedial action.

Question 2 recognizes this and asks whether the need addresses the long-term performance standards of the engineered unit. These standards can be as simple as a sign whose lettering is designed to last five years to a vitrified waste form that is designed to last 1,000 years.

The results of this query show 48 of the 152 needs related to the final engineered system performance. Of these, 15 were screened from the NMS database, 17 were obtained from interviews, 9 were located in memoranda, and 7 were found in the various reports. The breakdown by field office shows all field offices identifying at least one need that addresses final engineered system performance. The actual breakdown is as follows:

Field/Project Office	Number of needs
Albuquerque	1
Grand Junction	4
Idaho	15
Nevada	2
Ohio	10
Oak Ridge	3
Savannah River	2
Richland	5
Weldon Spring	1
Not site specific	5

A summary level look at these 48 needs shows a wide spectrum of needs. For instance there are needs related to modeling such as SR00-1030, *Model Degradation in Cement Based Wasteform*, which talks about the need to develop a model to simulate the degradation of saltstone, a cement-based wasteform, and the concrete vaults into which it is emplaced. Other needs pertain to sensors to monitor integrity of the engineered units such as need, ods-rep-emsp-1.2, *Sensors to Monitor Physical Integrity of Barriers, Structures, and Landfills*, which expresses a need to develop improved sensors to monitor physical integrity

of barriers, structures and landfills. Other needs fall into the category of understanding the performance of these engineered units such as AL-09-01-03-SC, *Succession and Long-Term Performance of Landfill Covers* which seeks to understand the effects of plant succession on the performance of landfill covers.

#### D. Data Management Improvement Analysis

Question 3 raises the issue of does the identified need improve data management. For this evaluation, data management refers to the whole suite of activities associated with the long-term stewardship data. It includes not only the collection, but also the analysis, interpretation, presentation and retention of the data. This question resulted in the identification of 11 needs. Most of the field offices identified at least one need. The actual breakdown by field office shows Idaho with 4 needs, Ohio and Albuquerque with 2 needs each, and Savannah River, Chicago, and Richland each having 1 need. One of the needs was not site specific. Five of these needs were identified during the screening of the NMS database; two were obtained through the interview process, three were found in memoranda, and one was described in a report.

A big-picture look at these needs shows they fall into a few similar categories and express a concern over aspects of long term viability of the data where viability includes not only the retention but also the collection, availability, retrievability, and ease of access. For example one need, ods-memo-id-1.6, *Tools for the Management of Information for Future Generations*, specifies a need to develop tools to ensure information management and transfer to future generations. One need AL-09-02-02-SC, *Environmental Restoration Site Hazard Information System*, expressed a need for the information system to be able to provide site hazard information in real time for future site activities including emergency

response. Other needs such as ods-memo-oh-1.11, *Integrated Real Time Sensor and Data Transmission System*, describes a need to develop an integrated system to collect, store, and transmit data in real time.

#### E. Understanding of Fate and Transport Analysis

Question 4 relates to a better understanding of fate and transport and refers to those processes and associated models that affect the movement, behavior and condition of contaminants and include physical, biological, chemical, and nuclear transformations.

Transformations include volatilization, biodegradation, oxidation and radioactive decay.

This inquiry identified 64 of 152 needs related to the fate and transport matters. This is a large percentage and correlates directly with the general lack of understanding of the contaminant behavior in the subsurface. The field office breakdown includes most of the sites evaluated with the details as follows:

Field Office	Number of needs
Albuquerque	8
Idaho	15
Nevada	3
Oak Ridge	1
Ohio	1
Richland	27

Seven of the needs were not site specific. The vast majority (53 of 64) of these needs were identified by review of the NMS database. Two needs were obtained during the interviews; seven needs were found in reports and two needs were located in memoranda.

For the most part many of these subsurface needs were descriptions of site-specific information gaps and covered a wide range of topics. In some sense collectively they resembled a list of everything one would like to know about the subsurface at a particular site. For example, Need ID AL-09-01-06-SC-S, *Issue of Scale in Flow Prediction and Contaminant Remediation in Porous Media* identified the specific matter "scaling" in flow prediction and contaminant transport. Another example, Need ID RL-SS25S-S, *Detection/Distribution of Contaminants – Chemical Form and Mobility of Dense, Non-Aqueous Phase Liquids in Hanford Subsurface* identified several key science needs for understanding non-aqueous phase form and mobility, etc.

Other needs were more all encompassing and addressed several components of a complex situation such as AL-09-01-01-SC, *Transport of HE and Metals in Fractured Rock and Surface Alluvial Systems*, which raised issues about the delineation and understanding of transport pathways in heterogeneous fractured media; identification of recharge sources; dynamics of contaminant transport in surface alluvial systems; connectivity between individual sites and contaminated waters in the alluvial system and groundwater; and the effects of contaminants on ecological receptors. This complicates any numerical interpretation of the analysis in that an individual NMS need can represent more than one LTS S&T need.

In general, about 30 of the needs expressed a need to know about the physics of fate and transport of contaminants in the vadose zone and alluvial systems. About 15 of the needs expressed a need for development and improvement of models to describe and predict the contaminant fate and transport. Eight of the needs addressed the need for sensors and instrumentation. Five of these needs asked for better contaminant detection, four of the

needs asked for better measurement of physical properties such as moisture content and pressure; two of the needs asked for better measurements of biological activity, and one need identified in situ field measurements as a long-term need. The remaining needs expressed a variety of matters including microbial alterations and connectivity between surface waters and groundwater.

#### F. Long Term Surveillance and Monitoring Analysis

The needs screening process, utilizing the eight questions contained in the Screening Matrix (Attachment A), resulted in the identification of 76 needs pertaining to long-term surveillance and monitoring (LTS&M). It is no surprise that the LTS&M screening subcategory contains the second largest number of associated needs (second only to risk prediction), since the primary objective of Long Term Stewardship is to protect human health and environment from hazards. Improved long term surveillance and monitoring systems are required to more effectively collect, measure, analyze, verify, and validate this objective.

In addition, there is a direct correlation and application of LTS&M to the need for "greater knowledge and better understanding of subsurface science," since improved subsurface sensors and monitors will enable researchers to better define the fate and transport of contaminants through the vadose zone. An example of such a need is ID-S.1.04, "Real Time Field Instrumentation for Characterization and Monitoring Soils and Groundwater," which identifies a need for faster and cheaper detection devices to aid in soil and groundwater characterization, sampling, and monitoring of contaminants in the subsurface.

Surveillance and monitoring also applies to the need for a greater understanding of the subsurface conditions beneath engineered units and facilities. An example is ods-int-id-2.1, "Better Surveying and Monitoring Devices," which describes a need for

improved contaminant monitoring below a facility left in place and a method to detect possible subsidence of capped engineered units.

Surveillance and Monitoring needs were identified from across the entire DOE complex. The distribution of needs is as follows:

AL	4	Ohio	12
СН	1	ORNL	6
Grand Junction	4	Richland	8
Idaho	25	Savannah River	2
Nevada	4	Weldon Spring	1

Nine needs were identified as "non-site specific" or complex-wide.

Of the 76 needs, 31 were derived from the NMS, 21 from site interviews, 13 from published reports, and 11 from memoranda.

The future challenge for surveillance and monitoring, based on the needs identified, will be in our ability to develop S&M systems that will perform accurately, reliably, remotely, continuously, in-situ, and for long periods in hostile environments.

#### G. Non-Science and Technology Long-Term Stewardship Analysis

During the identification of needs phase of the assessment process, it became clear that the sources of information contained other key long-term stewardship needs that did not fall within our definition of science and technology. Since these needs would be critical to the success of any stewardship program, it was decided that it would be appropriate to capture these needs separately. This effort will facilitate future consideration of these needs by other aspects of the long-term stewardship program.

The screening process identified 13 different non-S&T long-term stewardship needs. Two of these needs were found in the NMS database, eight were gleaned from reports and memos, and three were identified through the interview process. Although there were field office designations for a few of these needs, the essence of all thirteen of the needs applies across the complex.

These thirteen needs dealt with seven distinct subcategories. Five of the needs pertained to proper management of research. For example, need ods-rep-3.7, *Integration of the Research Community to Broaden Community of Researchers*, stresses the need to integrate research from government agencies with the research capabilities of the national laboratories, universities, and industry. Two of the needs pertained to security and access control. Two other needs addressed retention of scientific expertise. The last four needs specified life cycle cost estimating, stakeholder participation, land use impacts, and configuration management as being key matters for the Long-Term Stewardship Program.

#### H. Improve Confidence in the Risk Prediction Analysis

Question 7 asks whether the need improves confidence in the risk prediction.

Probably the overarching need of the long-term stewardship program is a need to better understand the impacts (the risk) of the contaminated site. This improved understanding can take the form of reducing the uncertainty of what is understood. This understanding will help to ensure that the long-term stewardship actions are both necessary and sufficient. Answers to this question resulted in 97 of the needs, which if satisfied, would result in improved confidence in the risk predictions. Every site in this assessment had a need associated with this question. The detailed breakdown is as follows:

Field/Project Office	Number of Needs Identified
Albuquerque	10
Chicago	1
Idaho	26
Nevada	3
Grand Junction	3
Ohio	5
Oak Ridge	5
Richland	32
Savannah River	3
Weldon Spring	1

Eight needs were not specific to a particular site. The breakdown by data source shows 70 needs were obtained from a review of the NMS database; 13 were gathered during the interviews; 5 were found in memoranda, and 9 of the needs were gleaned from reports.

A large percentage of the 97 needs, not surprisingly, were in the subsurface science area — an area of large uncertainty with potentially major impacts to any risk prediction. A better understanding of the fate and transport of contaminants will lead directly to a better understanding of the risk. Likewise a better understanding of waste form performance will lead directly to greater confidence in the risk projections. Equally obvious are those needs associated with toxicity which will have a direct link to any risk impact. The last major category will be those needs related to better sensing devices that are more reliable, accurate, and durable. These better measurements will allow for the development of better validation models and increased confidence in the risk estimates.

#### I. Enhance the Ability to Respond to Failure Analysis

Question 8 wants to know if the resolution of the need will enhance the ability to respond to failure. One of the components of a good stewardship program is the ability to respond in a timely and appropriate manner to any failure, and to be able to determine in advance when a failure occurs. The assessment identified twelve needs that answered Question 8 positively. Of these twelve needs, six were from the Ohio Field Office, two were from the Idaho Field Office, and one need each from the Albuquerque, Oak Ridge and Richland Field Offices. One need did not pertain to any particular site. By data sources, two of the needs arose from the NMS database, two needs were gleaned from reports, two needs were obtained from the reports and the remaining six needs were identified in memoranda.

An overview evaluation of these twelve needs centers on the early detection of system failure. For instance, ods- memo-oh-1.13, *Real-time Leachate Detection and Measurement System*, describes the need for a real time monitoring and sensing system to determine the integrity of leachate collection systems and detect leaks in collection system lines. One need, AL-09-02-02-SC, *Environmental Restoration Site Hazard Information System*, highlights the need to ensure the availability and retrievability of site hazard information in real time for future site activities including emergency response.

#### J. LTS Screening Category Analysis

The 152 included LTS needs are further cross-cut and segmented into five distinct screening categories to provide yet another perspective: (1) Waste Form/Physical Barriers; (2) Data Collection/Transmission; (3) Information Management; (4) Environmental Setting; and (5) Cross Cutting. The relationship between the screening categories and the site types

(i.e., soil, water, facilities, engineered units) is depicted in the Needs Screening Matrix (Attachment A of this Appendix).

The table below quantifies the results of the LTS needs using the screening categories sort. The total number of associated needs do not equate to the 152 total included needs because many of the needs are associated with more than one category. Segregating the needs using these sorting criteria shows a significant number (50%) of the total LTS needs involve the "Environmental Setting," validating the complex-wide need for a greater understanding of subsurface science. Descriptions of the five screening categories are provided below, including the individual attributes that further describe the needs sorting subcategories.

Screening Category	Associated Needs	Percent of Total
Waste Forms/Physical Barriers	49	18%
Data Collection/Transmission	38	14%
Information Management	12	5%
Environmental Setting	133	50%
Cross Cutting	35	13%

Waste Forms/Physical Barriers – This category includes LTS needs associated with ensuring the durability, maintainability, monitoring, predictability, inspection frequency, and inspection cost of waste forms (such as grout, vitrification, etc.) and physical barriers (such as engineered caps/covers, landfills, etc.). Forty-nine needs are associated with waste forms/physical barriers. The majority of the needs are associated with ensuring or validating the integrity and performance of waste forms or physical barriers. Examples of these include

needs associated with improved monitoring techniques (AL-00-01-04-SC, "Long-Term Monitoring Strategies and Techniques to Evaluate the Design of Material Disposal Area Engineered Covers"), and methods to monitor and detect barrier failure, or improved intrusion protection systems (ods-int-gjpo, "Ways to Strengthen Physical or Institutional Controls").

Data Collection/Transmission – This category includes LTS needs associated with improving the collection and transmittal data, including field sensors and devices, their durability, maintainability, calibration, inspection frequency, and the cost of inspection. Thirty-eight needs were identified in the data collection/transmission screening category. Typical examples include the need associated with the development of in-situ monitoring devices that can analyze and transmit remotely with little or no human intervention (ods-int-id-3.1, "In-Situ Samplers to Detect Contaminant Movement"), and more generic needs associated with the design and development of meteorological data transmission stations (ods-meme-oh-1, Automated Meteorological Monitoring Stations).

Information Management – This category includes LTS needs associated with improving data analysis and interpretation, reporting, accessibility, retention, records management, and the cost of records management. There are 12 needs associated with the information management screening category. A typical example includes the need associated with the cost effective storage, retention, retrieval, and protection of information (ods-memo-oh-1.1, "Long Term Record Keeping and Retrievability").

Environmental Setting – This category includes LTS needs associated with gaining greater knowledge and understanding of the environmental setting (geological and hydrological environment where contaminants reside) related to contaminant modeling, fate and transport,

toxicity, ecological indicators, uncertainty analysis, subsurface issues, model validation, and system performance validation activities. There are 133 needs associated with the environmental setting screening category, the majority of which are related to gaining a better understanding of subsurface science and how contaminants interact with and move through the vadose zone (ods-rep-4.2, "Full Capabilities of Vadose Zone Characterization, Prediction, and Monitoring"). Other needs focus on improving our ability to monitor for leaks, groundwater conditions, and physical changes in the subsurface (ods-int-id-6.2, "Reliable Monitoring Network for Groundwater").

Cross Cutting – This category includes LTS needs associated with advancing state-of-the-art, long term monitoring capabilities and risk determination methods that cross-cut all screening categories. There are 35 needs associated with the cross cutting screening category. An example of a cross cutting need is long term monitoring and surveillance systems, with remote data collection and transmission attributes (AL-09-02-01-SC, "Long-Term Site Monitoring System").

#### III. Analysis of Second Screening by Logical Categories

After reviewing the results discussed above, it was determined that "manually" sorting the set of LTS needs into other logical categories would be useful. The set of 152 needs was re-classified by evaluating the need title, plain language description, and other characteristics and attributes from the data presented above. From this exercise, the needs were found to fall into the following general categories:

- Subsurface Science
- Surveillance and Monitoring
- Caps and Covers
- Information Management
- Physical Barriers
- Ecosystem Monitoring
- Toxicity
- Non-Science and Technology

The needs that were placed into these eight logical categories were then analyzed, and the results of those analyses are presented below.

#### A. Analysis of Subsurface Science Needs

To no surprise, many (57) of the 152 needs pertain to subsurface science. This category includes not only the need for a basic understanding of the physical, chemical, biological, and nuclear processes associated with the fate and transport of contaminants in the subsurface, but also the need for the physical and computational modeling to predict concentrations of a contaminants throughout time in the various media, such as the

groundwater, vadose zone, and surface water. This area also includes the need for the validation of existing models and the need to reduce the uncertainty of the modeling results.

A few words about the inclusion of the subsurface needs in the LTS S&T needs are warranted. Until the fate and transport of contaminants at the site in question are understood and the long-term impacts of these contaminants on the environment and human health can be predicted, appropriate cleanup decisions can not be made. However, for the purposes of this needs assessment, the needs were included in the long term stewardship analysis since a lot of clean up decisions have been made and will be made with incomplete information and knowledge. Resolution of these matters can lead to greater confidence in the planned and existing stewardship activities and ultimately to the identification of cost saving measures.

Of the 57 needs identified that were related to subsurface science, 51 were obtained from the Needs Management System, 5 from reports, and 1 from an INEEL internal memo. These 57 needs are associated with the various field offices as follows: 28 from Richland; 12 from Idaho; 8 from Albuquerque; 2 from Oak Ridge; and 1 from Savannah River. Six of the needs were not site specific and apply generically. Due to the nature of the vadose zone, all 57 of these needs were placed in both the contaminated soil and the contaminated water site categories.

For the most part, many of these subsurface needs were descriptions of site specific information gaps and covered a wide range of topics. In some sense, collectively they resembled a list of everything one would like to know about the subsurface at a particular site. For example, Need ID AL-09-01-06-SC-S, *Issue of Scale in Flow Prediction and Contaminant Remediation in Porous Media*, identified the specific matter "scaling" in flow prediction and contaminant transport. Another example, Need ID RL-SS25S-S,

Detection/Distribution of Contaminants – Chemical Form and Mobility of Dense,

Non-Aqueous Phase Liquids in Hanford Subsurface, identified several key science needs for understanding non-aqueous phase form and mobility, etc.

Other needs were all encompassing and addressed several components of a complex situation such as AL-09-01-01-SC, *Transport of HE and Metals in Fractured Rock and Surface Alluvial Systems*, which raised issues about the delineation and understanding of transport pathways in heterogeneous fractured media; identification of recharge sources; dynamics of contaminant transport in surface alluvial systems; connectivity between individual sites and contaminated waters in the alluvial system and groundwater; and the effects of contaminants on ecological receptors. This complicates any numerical interpretation of the analysis in that an individual NMS need can represent more than one LTS S&T need.

In general, about 30 of the needs addressed our understanding of the physics of, fate of, and transport of contaminants in the vadose zone and alluvial systems. About 15 of the needs expressed a need for development and improvement of models to describe and predict the contaminant fate and transport. Eight of the needs addressed the need for sensors and instrumentation. Five of these needs asked for better contaminant detection, four of the needs asked for better measurement of physical properties such as moisture content and pressure; two of the needs asked for better measurements of biological activity, and one need identified in situ field measurements as a long-term need. The remaining needs expressed a variety of matters including microbial alterations and connectivity between surface water and groundwater.

This assessment included the review of two major reports that have addressed the complex wide needs relative to the subsurface. These reports were the National Research Council's Research Needs in Subsurface Science, and an INEEL Draft Report, DOE Complex-wide Vadose Zone Science and Technology Roadmap: Characterization, Modeling, and Simulation of Subsurface Contaminant Fate and Transport. The vast majority of the needs identified in these two documents pertained more to the focus, direction, and management of the research needed rather than specific research needs. The set of Subsurface Science needs is Attachment C of this Appendix.

#### B. Analysis of Surveillance and Monitoring Needs

The Surveillance and Monitoring needs area contains 65 of the 152 LTS needs, representing 42% of the total needs (Attachment D of this Appendix). These needs are divided into seven distinct subcategories. Each of the subcategory definitions is provided below, along with an example extracted from the needs database. Need's summaries are provided for each subcategory along with the distribution of included needs by DOE Field Office. Twenty-two needs were derived from the NMS, twenty-one from interviews, nine from reports, and thirteen were extracted from memoranda issued by various field offices. Surveillance and Monitoring needs summarized by contaminated site types were distributed as:

- Soil 39
- Water 39
- Facilities 17
- Engineered Units 33

*Instruments, Sensors and other Devices* – Needs in this category require the development of new instruments or sensors to perform mapping, characterization, monitoring, or surveillance functions directed toward increasing our knowledge and understanding of how contaminants move in the subsurface.

There were 29 needs included in this subcategory. The distribution of these needs by Field Office is as follows:

Albuquerque 2

Chicago 1

Grand Junction 1

Idaho 11

Nevada 2

Oak Ridge 3

Ohio 4

Richland 1

transmit soil or water related data.

In addition, EMSP identified one need, and three more were included in various complex-wide reports, for a total of twenty-nine. An example of a need included in this category is:

CH-SS04-99 – "Long-Term Groundwater Monitoring," a need for enhanced or new monitoring techniques that allow more reliable, quick and inexpensive groundwater analysis.

Data Collection, Sampling and Analysis – Needs in this category require the development of surveillance and monitoring devices to improve our ability to sample, collect, analyze, and

There were four needs included in this subcategory: two from Idaho and one each from Nevada and Ohio.

An example of a need included in this category is: ods-int-id-3.1 – "*In-Situ Samplers to Detect Contaminant Movement*," a need for in-situ samplers that can detect and send data remotely, with little or no human intervention.

Greater Understanding of Subsurface Science – Needs in this category require the development of improved sensors and monitors to advance the science and gain a better understanding of how various contaminants reside, interact with, and/or move through multiple below ground configurations.

There were two needs identified in this subcategory, one each from Idaho and Richland. An example of a need included in this category is: RL-SS37-S – "Monitoring of Contaminants – Chemical Sensor Principles," a need to develop a better understanding of the physics and chemistry that will lead to more accurate and more sensitive measurements of contaminant concentrations.

Ensuring the Integrity and Longevity of Entombed Facilities – Needs in this category require the development of in-situ monitors, sensors, or surveillance systems to ensure the integrity and long-term performance of facilities. This includes entombed reactors, canyons, and other buildings whose residual contamination has been left in place.

Eight needs were identified in this subcategory: four from Idaho, three from Ohio, and one from Richland. An example of a need included in this category is: ods-int-id-2.1 – "Better Surveying and Monitoring Devices," a need for improved contaminant monitoring below a facility left in place.

Ensuring the Integrity and Longevity of Engineered Units - Needs in this category require the development of in-situ monitors, sensors, or surveillance systems to ensure the integrity

and long-term performance of engineered units. This includes landfills, caps and covers, and other land-based storage or waste disposal units.

There were a total of eighteen needs identified in this subcategory: six each from Idaho and Ohio, one each from Albuquerque, Grand Junction, Oak Ridge, Savannah River, and Weldon Springs. In addition, EMSP reported one need for a total of eighteen.

An example of a need included in this category is: ods-int-gjpo-1.5 – "Ways to Measure Moisture Flows in Caps," a need to develop a more cost effective, remotely operated device to measure moisture in/under caps and covers.

*Ecosystems* – Needs in this category require the development of improved sensors, monitors, and surveillance systems to assess the natural environment surrounding engineered units and entombed facilities to minimize the impacts on human health and the environment.

Two needs were included in the *Ecosystems* subcategory. The distribution of these needs was one reported by EMSP and one identified by the Idaho Field Office. An example of a need included in this subcategory is: ods-rep-emsp-1.3 – "*Remote Sensing of Ecosystems*," a need to develop improved remote sensing of ecosystem indicators including vegetation.

*Physical Barriers* – Needs identified in this category require the development of surveillance and monitoring devices for the detection and alarm of human intrusion into hazardous facilities, and engineered units.

One need was identified in the *Physical Barriers* subcategory: ods-int-gjpo-1.3 – "*Ways to Strengthen Physical or Institutional Controls*," a need for improved physical barriers and intrusion prevention systems.

#### C. Analysis of Caps and Covers Needs

Six needs were derived from the NMS, four from interviews, one from published reports, and one was extracted from a field office memorandum. These needs were assigned to contaminated site types (media) as follows:

- Soil 1
- Water 0
- Facilities 2
- Engineered Units 12

Needs identified in this subcategory, listed in Attachment E of this appendix, require improved designs that will ensure the long-term performance and integrity of landfills, caps and covers, and other land-based storage or waste disposal units configured with engineered controls.

Twelve needs were identified in this category. The distribution of these needs by Field Office is:

- Albuquerque 2
- GJPO 1
- Idaho 4
- Nevada 2
- Ohio 1
- ORNL 1
- Richland 1

An example of a need included in this subcategory is: NV11-0001-08 – "Long Term Management of Void Space, Containers, and Cover Subsidence Disposed," a need to develop

methods to better predict the dynamics of collapse of void space, container/waste form degradation, and subsidence of cap materials.

#### D. Analysis of Information Management Needs

Of the 152 LTS S&T needs, 9 were found to pertain to information and data management improvement and are listed in Attachment F of this appendix. Whether needs involved improved systems for site characterization data, baseline inventories, or long term monitoring and surveillance of contaminants, there appears to be a general need for consistency in application and dependable information management systems where information can be recorded, stored, preserved, and easily accessed over the long term.

For the purposes of this analysis LTS Information Management needs refers to the whole suite of activities associated with the LTS data. It includes not only the LTS activity needs and related data collection, but also the analysis, interpretation, presentation, and retention of the data. Another way of describing LTS information management needs included under this category are those LTS needs required to develop the ability to store, retrieve, transmit, and ensure the security of historical information.

Four LTS information management needs came from the NMS database. One from Albuquerque (need for a real time information system, including emergency response, to ensure the availability and retrieval of site hazard information) for future site activities. Two were from Richland (a need for a single and consistent inventory of the discharges and disposals of radionuclides and chemicals to the surface and subsurface and to record any discharges to the Columbia River and the other improved information management by supporting better data in models). One other came from Savannah River (a need to develop a relational database to allow storage and retrieval of data including photos and videos).

Two information management needs were identified from the INEEL Site Interviews involving two different interview groups as sources. The Site-wide Monitoring and Surveillance Group indicated a need for a long-term storage and retrieval system dealing with groundwater data and log books since no formal systems for managing them exists. The Spent Nuclear Fuel Program noted a need for an information and records management system to define, record and store information dealing with fuels to be sent to the repository.

Two other information management needs resulted from memoranda that discussed LTS needs. One of these came from Fernald and it described the need to develop a long-term record keeping system that is easily accessed and maintained. Another memorandum summarizing S&T needs unique to LTS that were related to complex-wide concerns noted a need to develop a system to maintain and readily access critical information needed to maintain engineering and institutional controls for long periods of time.

One final need was identified from a report that contains a summary of information needs. During the review of LTS needs which fall within post-cleanup activities related to information and data management, one report ("Managing Data for Long Term Stewardship," prepared by ICF Kaiser) involved a detailed study of the type of LTS data needs and information management. The report concluded that most types of information needed for stewardship is already being generated for other purposes, but these data are sometimes destroyed or lost once cleanup is completed and it is not being kept in a way which is user friendly to access or search. Among several information related LTS needs identified from this report is the need for LTS data standards and fields, activity sensitive data locators, and Metadata descriptors (that describe electronic content searches). Existing

data locators and descriptors are not stewardship or LTS activity sensitive, nor are they consistent in content of documents or databases.

#### E. Analysis of Physical Barriers Needs

Waste Forms/Physical Barriers includes "passive stewardship" measures (e.g., custodial controls such as land or resource use restrictions, permanent markers, signs, or restrictions at a site), and more proactive measures to reduce or eliminate the human intrusion into entombed facilities, engineered units (caps, covers, and landfills), waste disposal and other hazardous areas. Attachment G lists the Physical Barrier Needs. As can be seen, there are three subcategories within the Waste Form/Physical Barriers need area. Definitions for each of the subcategories are provided below, along with an example extracted from the needs database. Need's summaries are provided for each subcategory along with the distribution of included needs by DOE Field Office. Physical Barrier needs summarized by contaminated site types were distributed as:

- Soil 0
- Water 0
- Facilities 8
- Engineered Units 14

Twelve Physical Barrier needs were identified. Six (needs were derived from the NMS, four were obtained from interviews, one came from published reports, and one was extracted from a field office memorandum.

*Ensuring the Physical Integrity of Waste Forms* – Needs identified in this subcategory require improved designs and systems to ensure the long-term integrity, sustainability, and performance of waste forms, storage containers, engineered units, and physical barriers.

Ten needs were identified in the *Physical Integrity of Waste Forms* subcategory. The distribution of these needs by Field Office is:

- GJPO 2
- Idaho 2
- Ohio 3
- ORNL 1
- Richland 1
- Savannah River 1

An example of a need included in this subcategory is: ods-rep-4.3 – "Better Analysis and Assessment Stages for Repository Sites," a need for an improved repository design that creates no undue future risk.

**Subsurface Science** – Needs in this subcategory require a greater understanding of waste form behavior within the subsurface environment.

One need was identified in this subcategory: ID-S-1.12 – "Understanding the Behavior of Waste Forms and Their Near-Field Transport," a need to improve conceptual models to more accurately estimate releases from contaminant waste forms.

*Physical Barriers* – Needs identified in this subcategory require the development of improved designs, methods, and systems to minimize or eliminate human intrusion into entombed facilities, engineered units, and/or waste disposal and other hazardous areas.

Two needs were identified in this subcategory: both were obtained from the Grand Junction Project Office, within the Albuquerque Field Office.

An example of a need in this subcategory is: ods-int-gjpo-1.2 "Long-Life Signage," a need for improved, more durable signs that are more resistant to weather and vandalism.

#### F. Analysis of Ecosystem Monitoring Needs

From the second screening to place needs in logical categories, there were two needs associated with the environmental setting of the site (see Attachment H). One need was directed toward understanding the potential impacts to the surrounding ecology. This need from the AL field office, AL-09-01-16-Risk-S, Extrapolation bias and Uncertainty from using Biomarkers and Numerical Models to Predict Real Ecological Effects, identifies a fundamental need for field data to test model assumptions and to quantify the uncertainty around using biological indicators and numerical modeling results as indices of population and ecosystem changes. The second need to develop remote sensing capability of ecological indicators. This need, ods-rep-emsp-1.3, Remote Sensing of Ecosystems, originated from the Environmental Management Science Program Sensors Initiative for Identification of Long Term Stewardship Research Needs. This was a workshop held in Idaho Falls in June of this year with representation from INEEL, ANL-W, ANL-E, Fernald, ORNL, PNNL, Paducah, Portsmouth, SRS, SNL, Nevada, and the Characterization, Monitoring and Sensor Technology Program. Both of these needs have complex-wide applicability and fall into the soil category.

#### G. Analysis of Toxicity Needs

The LTS S&T search also identified two needs that fit in the toxicity category as listed in Attachment I. In this case toxicity refers to the adverse effects that a contaminant might have on human health and the environment. The first of these needs, from the Idaho office, ID-S.1.16, *Quantifying Uncertainty in Risk Calculations*, expresses a need for determining the health effects from mixtures of contaminants as well as understanding the uncertainty in the toxicity component of the risk calculations. Although identified as a need

in Idaho, this need would apply complex-wide. The second need from the Richland field office, RL-SS39, *Understand and Provide Means to Quantify the Impacts of River Contamination on Receptors*, expresses a need for the development of appropriate toxicological benchmarks for key river species and for understanding the translation of benchmarks to higher level ecological impacts. These needs do not readily fall into any of the contaminated site categories of soil, water, engineered units, or facilities.

#### H. Analysis of Non-Science and Technology Needs

The screening for non-science and technology needs did not change for the second screening because needs that were classified as non-S&T were not screened or categorized further. Refer to Attachment J and the previous analysis of this topic.

#### I. Screening Results for Contaminated Site Type (Media)

As needs were being screened using the screening questions and categories, they were also labeled as to which media or contaminated site type each need was applicable. The four media considered were:

- Water (surface and groundwater)
- Soil (which includes soils, sediments, burial grounds or other disposal areas that do not have engineered containment structures)
- Engineered units (permanent, land-based disposal units such as landfills, vaults, and tanks that have engineered containment structures such as caps or covers, liners, and leachate collection systems; also units designed for longterm retrievable storage of nuclear materials)
- Facilities (facilities that will have contamination remaining, including entombed facilities, or facilities that are demolished to grade and capped)

From the original screening of the 152 needs as shown in Attachment K of this appendix, the results by media were:

Water 100
Soil 46
Engineered Units 66
Facilities 18

Many needs were assigned to more than one contaminated site type, therefore, the total is greater than 152.

As was previously mentioned, the entire set of LTS needs was screened a second time and sorted into logical categories. When this second screening was done, the assignment of needs to the contaminated site types was re-done also. This second screening was done after considerable discussion of how the needs were categorized and what the data revealed. The assignment of media type during this second screening yielded somewhat different results. The differences were due to the fact that the review team was more familiar with the entire set of needs, and that the assignment of media type (especially to the large set of subsurface science needs) was done more consistently. Specifically, nearly all of the subsurface related needs were labeled as being applicable to both water and soil during the second screening, and that was not the case in the original screening. The treatment of engineered units and facilities was also more consistent the second time. For these reasons, the results from the second evaluation are more accurate than the first. The revised results are:

Water 98
Soil 98
Engineered Units 59
Facilities 32

Water and soil were the most common media because of the presence of vadose zone and subsurface science issues across the complex. Also, most surveillance and monitoring activities will be conducted in these media at many sites.

Engineered units (59) was the next largest site type. Many sites demonstrated needs for improved surveillance and monitoring of the system performance of engineered landfills and disposal cell caps, covers, physical barriers, leachate collection systems, and other ways to improve design for longevity and cost effectiveness.

Facilities were the lowest (32) site type. Many structures will be decontaminated and demolished, and may have caps or covers placed over remaining material. For other structures, the safest and most cost effective solution may be entombment. There were needs identified for monitoring or surveillance of these facilities as well.

Attachments B through J of this Appendix show how the needs were sorted by logical categories (i.e., subsurface science, caps and covers, surveillance and monitoring, etc.), and each attachment includes a "contaminated site type" column in order to show how the contaminated site type designation is related to each category.

#### IV. Findings

A methodology was established for identifying science and technology needs that are associated with long-term stewardship. The methodology was useful for screening and categorizing the needs so they could be analyzed or evaluated to identify common themes or potential areas where research should be emphasized. Although some general conclusions can be drawn from the analyses presented in this initial assessment, the information is too preliminary to be used to make substantial conclusions or firm decisions regarding the funding of research or technology development. This is true because of several factors.

One factor is that the main sources of data were existing information about needs (like the NMS and reports), and although good sources of information, they were not developed with long-term stewardship principles in mind.

Some previously unidentified needs were developed from the interviews that were conducted as part of this assessment. Although a significant number of operations-oriented personnel were interviewed, a commonly expressed thought was, "I really haven't thought much about long-term stewardship." That is certainly understandable given the short-term deadlines, regulatory milestones, and the annual budget cycle of DOE programs. Other operations or program personnel (correctly) viewed their role only as remediation, stabilization, treatment, demolition, or long-term storage prior to offsite disposition. The responsibility for stewardship would then be passed on to someone else. The concept of long-term stewardship is relatively new within DOE, and the definitions of exactly what constitutes stewardship, when it begins, and who is responsible are not widely understood. Thus, it was difficult in the relatively short time available for interviews (even though the questions and assumptions were provided to interviewees beforehand) to identify well thought out, validated needs related to long-term stewardship. Interviews would be an important means of identifying and developing such needs, but it would require development of additional guidance and more commitment of time than were available in this phase.

Another limitation of the screening process for the initial needs assessment was that the screening questions, categories, and attributes were not assigned weights or importance factors during this phase of the needs assessment. This step would be essential to providing a more credible and defensible set of needs. In addition, the process, questions and categories,

and weighting assignments should have wider input from around the DOE complex than was possible in this initial effort.

Given those limitations, there are some general findings resulting from the data collected. These are:

- There are many needs associated with a better, fundamental understanding of subsurface science, including fate and transport models, flow in fractured media, chemistry and physics associated with radionuclide and metal interaction with soil particles, etc. Some of these basic science needs are related to making better cleanup decisions, but they certainly impact activities beyond stewardship.
- There were a significant number of needs associated with improved or less
  costly methods for monitoring and surveillance of contaminated soil and
  water. These include sensor development for specific contaminants in
  specific media, automated and remotely operated systems, and automated data
  transmission.
- A moderate number of needs were related to improving the durability,
   maintainability or surveillance of caps and covers over engineered units or
   demolished or entombed facilities.
- Numerous needs were identified related to more reliable information/data management systems for storage and retrieval.

This assessment provided a useful methodology for identifying and categorizing S&T LTS needs as well as identifying broad areas where further research or technology development could impact future long-term stewardship activities. This initial needs

assessment, along with the technology baseline inventory, sets the stage for preparation of a "roadmap" that will further define the direction of needed research and development.

Although useful at this stage, further refinement of the process and broader application at other sites will yield a better defined set of needs, from which to make more reliable prioritization and funding decisions.

# Glossary of Appendix A -- (Interview Questions, Screening Criteria, and Definitions)

# Long-Term Stewardship Science & Technology Needs

#### Interview Questions/Assumptions

#### **Objective:**

The purpose of conducting the Long-Term Stewardship (LTS) interviews is to stimulate discussion that will lead to the identification of new S&T needs (in addition to those already included elsewhere, e.g., those coordinated by the Site Technology Coordination Group (STCG) or included in the Needs Management System (NMS) database). These will be included in a baseline of needs for determining future Science and Technology requirements related to LTS. LTS activities are those required to ensure the protection of human health and the environment after cleanup, disposal, or stabilization is complete, and may include things like long -term monitoring, inspection, and surveillance, or long-term operation of a remedy such as a pump and treat system.

#### **Assumptions:**

- 1. Cleanup, disposal, or stabilization has been completed to acceptable standards and the end state is defined (often as a result of negotiation with regulators and stakeholders e.g., RODs or stakeholder-approved future land use plans, etc.). (NOTE: This will usually be the case. However, there may be cases such as interim RODs where the "decision" has not been finalized, and LTS activities may be still be factored into the final decision.)
- 2. Even though it may not be known at this time what person or group will be responsible for LTS activities in the future (or if there will be a separate LTS organization or program), assume for this discussion that it will be your responsibility to carry out appropriate LTS actions. Your responsibility then is to ensure and demonstrate protection of human health and the environment in a given facility/area after cleanup, disposal, or stabilization is complete.
- 3. Many facilities/areas/engineered units will require monitoring, surveillance, maintenance, or inspection to verify that the "remedy" (e.g., capped waste burial area, entombed nuclear facility, stabilized spent fuel storage) is performing as intended, or that the end state conditions continue to ensure protection of human health and the environment.
- 4. Current technologies may be costly to implement over a very long period of time, or involve risk to personnel and/or the environment. Therefore, solutions are being sought, (and funds are available to invest in new solutions) that will reduce technical and scientific uncertainty, improve the reliability, reduce worker risk or environmental impact, or reduce the cost of LTS activities.
- 5. LTS may continue for 25, 50,100 years or even in perpetuity.

# Questions: (examples are provided for illustration only – please think of specific examples applicable to your situation)

- 1. What types of hazards or residual contamination will remain after cleanup, disposal or stabilization is complete? (e.g., groundwater contamination, buried waste, immobilized radionuclides in structures, stabilized spent fuel in canisters, etc.).
- 2. Have or will the quantities of materials/contaminants remaining after cleanup, disposal or stabilization be quantified? (e.g., cubic feet of buried material, number of curies of what radionuclides, amount of contaminated groundwater, amount of spent fuel to be disposed).
- 3. What was the decision process and regulatory framework used to define the end state? Who was involved? Do Stakeholders agree? Who are the stakeholders? Are they the right ones?
- 4. What are the stewardship activities contemplated and what media or contaminants will need to be monitored or what measurements will need to be made to assure the validity of the assumptions? (e.g., radionuclides X, Y, and Z in monitoring wells, VOCs in air, moisture infiltration in landfill covers, corrosion rates of SNF storage containers, moisture in SNF dry storage facilities, measures of structural integrity at a stabilized nuclear facility, soil erosion).
- 5. What are the cost elements or drivers associated with anticipated LTS activities? (e.g., labor costs associated with sampling, maintenance costs of engineered barriers, surface radiation surveys or radiation monitoring of stabilized nuclear facilities, analytical laboratory costs, security or access control).
- 6. What are the expected regulatory/compliance drivers of anticipated LTS activities, and how do they impact the magnitude or cost of those activities? Try to make a distinction between the regulatory regime affecting cleanup or stabilization vs. LTS.
- 7. How would you prioritize your LTS activities? By risk to human health, environmental impact, program cost, or other parameter?
- 8. What baseline technologies are being considered or would you consider to accomplish LTS? (e.g., use of latest air/groundwater monitoring techniques utilizing satellite data transfer systems).
- 9. What is the contemplated schedule for beginning LTS activities? When will you require the solutions to meet your needs? (e.g., cleanup is scheduled for completion by FY-05, will need demonstrated LTS solution by FY-01).
- 10. What types of information will be important to collect, store, retrieve and interpret to ensure that the hazards are understood for generations to come. Are your information management systems adequate to accomplish the task of LTS? (i.e., can you assure that systems are in place to accommodate long-term storage, retrieval, and access of data?)
- 11. What would you expect to be the most difficult task associated with LTS?
- 12. What would you expect to be the most costly element of the LTS program?
- 13. Who or what will you be trying to protect after cleanup is complete (e.g., workers, ranchers, potential intruders, local biota, drinking water) and for how long? What specific needs do you have to ensure protection of human health and the environment after cleanup is complete? (e.g., facility monitoring systems that can detect changes in entombment systems, ability to monitor contaminant concentrations and migration, etc.).

- 14. What feedback mechanisms will be used to determine when changes to frequency, magnitude, location, contaminants monitored, duration, or other parameters of the LTS program need to be changed based on monitoring results, new or improved technologies, or regulatory changes?
- 15. What are some scenarios that could lead to changes in the site/facility end state? (e.g., failure or compromise of engineered barrier from subsidence or bio-intrusion, degradation of concrete or grout leading to potential release of long-lived radionuclides from an entombed facility, corrosion of spent fuel canisters).
- 16. What are the key assumptions upon which predictive models or risk assessments are based and what needs to be done to determine if these have changed? Who monitors for these changes and how and at what frequency?
- 17. What major uncertainties exist? (e.g., durability of engineered caps or barriers, life expectancy of long-term grout containment, particular variables in fate and transport models, etc.).
- 18. Are you aware of any anticipated or potential regulatory issues that may impact your ability to accomplish your LTS mission? (e.g., a regulatory change in acceptable contamination levels, future radiation exposure standards, etc.) Are there regulatory changes that would be desirable to have a positive impact on LTS activities?
- 19. Are you confident of your ability to accurately assess the LTS-related life-cycle costs associated with remedies already in place or alternative remedies being considered? (i.e., do you have a sound basis for estimates prepared or submitted? Are they defensible? Is the time frame used reasonable? Realistic? Do your estimates include contingency factors? If so, what are they based on?).
- 20. What is the most unreliable task associated with anticipated LTS activities?
- 21. Have you considered ways you could avoid or significantly reduce the cost or magnitude of LTS activities? What are they? What are the impediments to being able to implement such solutions/remedies? Do you have any thoughts as to whether better science and/or technology could overcome those impediments?
- 22. How would you envision R&D, operations, and LTS being integrated?
- 23. Are you aware of any special needs not yet described? (i.e., other needs not fully defined or characterized).

#### **Long-Term Stewardship Screening Criteria**

**Go/No-go Criterion:** Does this need deal with post-cleanup, -disposal or -stabilization activities?

#### **Additional Screening Questions:**

- 1. Does it pertain to site maintenance?
- 2. Is it or does it relate to final engineered system performance?
- 3. Does it involve long term monitoring and surveillance?
- 4. Does it contribute to greater understanding of fate and transport?
- 5. Does it improve data management?
- 6. Does it enhance overall confidence in risk prediction?
- 7. Does it pertain to a Non S&T need?
- 8. Does it enhance the ability to respond to failure in final configuration?

#### **Categories and Attributes:**

Applies to Waste Form or Physical Barriers?

- Durability
- Maintainability
- Ease of Monitoring
- Predictability
- Frequency of Inspection
- Cost of Inspection
- Contaminated Site Type
  - 1. Soil
  - 2. Water
  - 3. Engineered Units
  - 4. Facilities

#### Related to Data Collection/Transmission?

- Sensor/Device
- Durability
- Maintainability
- Calibration
- Frequency of Inspection
- Cost of Inspection
- Contaminated Site Type
  - 1. Soil
  - 2. Water
  - 3. Engineered Units
  - 4. Facilities

#### Deals with Information Management

- Data Analysis
- Data Interpretation
- Reporting
- Accessibility
- Retention
- Records Management
- Cost of Records Management
- Contaminated Site Type
  - 1. Soil
  - 2. Water
  - 3. Engineered Units
  - 4. Facilities

#### Related to Environmental Setting and System Performance Characteristics

- Contaminant Modeling
- Fate and Transport
- Toxicity
- Ecological Indicators
- Uncertainty Analysis
- Subsurface Issues
- Model Validation
- System Performance Validation
- Contaminated Site Type
  - 1. Soil
  - 2. Water
  - 3. Engineered Units
  - 4. Facilities

#### **Cross Cutting Issues**

- Long Term Monitoring and Surveillance
- Risk
- Contaminated Site Type
  - 1 Soil
  - 2. Water
  - 3. Engineered Units
  - 4. Facilities

#### LTS Screening Criteria Terms and Definitions

Post Cleanup – this refers to the time after all cleanup, stabilization and disposal has taken place and continues until the site has been released for unrestricted use.

Site Maintenance - This refers to those LTS activities that are strictly routine maintenance in nature. That is they are expected and planned for. These activities can include the environmental setting as well as any physical manmade structures.

Engineered System Performance – this refers to the fact that any manmade system structure or component will have associated with it a performance standard. It can be as simple as a sign whose lettering is designed to last 5 years, or as robust as a vitrified waste form designed to last 1000 years.

Long Term Monitoring – refers to those monitoring activities that begin or continue after cleanup, stabilization or disposal. This would include items such as groundwater and surface water monitoring.

Fate and Transport – this refers to those processes that affect the movement, behavior and condition of contaminants and include physical, biological, chemical and nuclear transformations. Processes like volatilization, biodegradation, oxidation, and radioactive decay are examples of such transformations.

Near and Far Field – this refers to the differing aspects of the problem. Near field problems can relate to the source term and its interaction with its immediate surrounding. Far field refers to matters several meters to kilometers from the source. Groundwater contamination is an example of a far field matter.

Data Management – refers to the whole suite of activities associated with the LTS data. It includes not only the collection, but also the analysis, interpretation, presentation, and retention of the data.

Non Science and Technology (S&T) matters – There are a lot of long term stewardship issues that are not S&T related, among these being stakeholder acceptance, institutional controls such as deed restrictions, economic projections, etc.

Durability – refers to the ability of an item, be it a waste form, a physical barrier, a sensor, etc., to last, to be able to withstand wear and tear.

Maintainability – refers to the ability to keep in a good condition and efficiency.

Ease of Monitoring – refers to monitoring that is easy to do, no great difficulty or effort is involved.

Predictability – refers to the condition of being able to understand and forecast the future with respect to the LTS site. This can include episodic environmental events such as flooding as well as how long a warning sign will last.

Calibration – refers to those activities associated with the systematic checking and adjusting of instrumentation.

Data Analysis – refers to those activities associated with the processes of going from raw data to final data and includes items such as verification, validation, and necessary computations.

Data Interpretation – refers to those activities associated with taking the finished data and making sense of what it all means, comparison to regulatory standards, comparison to predictive models, and presenting the results to interested parties.

Contaminant Modeling – refers to those activities associated with understanding, describing and predicting the movement of contaminants through the environment. Typically this is done with computers.

Toxicity – refers to those items that relate to the adverse effects that a contaminant might have on humans, plants or animals.

Ecological Indicators – refers to those items that indicate the health or impact of the surrounding ecology.

Uncertainty Analysis – refers to those activities associated with understanding the key siterelated attributes and assumptions that contribute most to the uncertainty of the risk calculations

Subsurface Issues – refers to the whole suite of activities needed to understand the behavior and movement of contaminants in the subsurface.

Model Validation – refers to those activities necessary to confirm the accuracy of the model results.

System Performance Validation – refers to those activities necessary to confirm and assure that the residual hazards and the associated barriers and environmental setting are behaving as expected.

Surveillance – refers to those activities associated with observing the site and its environs.

Risk – refers to those activities associated with determination of the impacts of the contaminants to human health including the worker and the public as well as the environment.

Frequency of inspection – refers to those activities associated with how often an inspection needs to take place. Generally speaking less frequent is better.

# **Attachment A -- Matrix Template**

NEED TITLE: NEED CODE:

PLAIN LANGUAGE:

# Pertains to site maintenance SCREENING QUESTIONS

Relates to final engineered system performance

Improves data management

understanding of fate and transport Contributes to better

Involves long term monitoring and surveillance

Pertains to non S and T

Durability Maintainability

Better confidence in risk prediction

Enhances ability to respond to failure in final configuration

**Environmental Setting** 

Cross Cutting

Model Validation System Performance Validation Water

Soil

**Engineered Units** Facilities

Uncertainty Analysis Subsurface Issues

Long-Term Monitoring Risk

Water Soil

Engineered Units Facilities

# SCREENING CATEGORIES

Waste Form/ Physical Barriers Monitoring Predictability Inspection Freq. Inspection Cost Water Soil **Engineered Units** Facilities Sensor/Device Durability Data Collection/ Maintainability Transmission Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facilities Data Analysis Management Information Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Contaminant Modeling Fate & Transport Toxicity **Ecological Indicators** 

Appendix A, Attachment A

### **Attachment B – List of All LTS Needs**

Need Code	Need Title	Category	Contaminate Site Type	ed Plain Language Non S & T
AL-00-01-04-SC	Long-term Monitoring Strategies and Techniques to Evaluate the Design of Material Disposal Area Engineered Covers	S&M,CC	EU	Improved Methods of Monitoring the Performance Or Stability of Engineered Caps Or Covers; Cost Savings Is a Goal.
AL-09-01-01-SC-S	Transport of HE and Metals In Fractured Rock and Surface Alluvial Systems	SS	S,W	Improved Understanding of the Movement of High Explosives (RDX) Components and Metal Contaminants (particularly Barium) Below Ground.
AL-09-01-03-SC-S	Succession and Long-term Performance of Landfill Covers	CC	EU	Effects On the Performance of Landfill Covers Caused By Plant Succession.
AL-09-01-06-SC-S	Issue of Scale In Flow Prediction and Contaminant Remediation In Porous Media	SS	S,W	Improved Ability to Predict Flow and Transport Below Ground That Captures the Large and Small Scale Physical Processes That Affect Water Movement.
AL-09-01-07-SC-S	Integration of Reactive Chemistry Into Field-scale Transport Models	SS	S,W	Improved Predictive Modeling Capabilities That Address Complex Chemical and Flow Processes.
AL-09-01-08-SC-S	Differences Between Saturated and Unsaturated Systems	SS	S,W	Contaminants Travel Differently In Wet and Dry Below Ground Environments. There Is a Need to Better Understand the Differences.
AL-09-01-10-SC-S	Physics of Fracture Flow and Transport In the Vadose Zone	SS	S,W	Better Understanding of the Importance of Cracks In Below Ground Water Movement Will Improve Models.
CC = Caps	eillance and Monitoring and Covers Face Science  PB = Physical Barrie Eco = Ecosystem M Tox = Toxicity	onitoring S F	/ = Water = Soil = Facilities U = Engineered Units	s Appendix A, Attachment B

Need Code	Need Title		Category	Contaminate Site Type	ed Plain Language N	lon S&T
AL-09-01-11-SC-S	Water Fluxes and Solute Tra Semiarid Environments	nsport In Arid and	SS	S,W	Better Understanding of Water Movement Over Time and Area In Arid and Semi-arid Underground Environments, and Water Vapor Exchange At the Ground Surface.	
AL-09-01-12-SC-S	Groundwater-surface Water	Interactions	SS	S,W	Better Understanding of the Interaction Between Groundwater and Surface Water, i.e., What Affect Does Groundwater Pumping Have On Streamflow, and What Affect Does Surface Water Diversion Have On Groundwater Recharge.	
AL-09-01-15-SC-S	Separation of Metals and Rac Uncontaminated Soils; Trans Radionuclides In Sediments Systems	port of Metals and	SS	S,W	Better Understanding of the Separation and Movement of Metals and Radionuclides From Soils and Sediment.	
AL-09-01-16-RISK-S	Extrapolation Bias and Unce Biomarkers and Numerical M Ecological Effects		ECO	S,W	A Better Understanding of the Relationship Between Field Data and Model Assumptions to Quantify the Uncertainty of Model Predictions of Ecological Risk.	
AL-09-01-33-NM	Core Scientific R&D Capabi Material Management Needs		ır		Need For Retention of Scientific Expertise (Chemistry and Physics) Related to Safety and Health Issues For Stabilization and Storage of Nuclear Materials.	x
AL-09-02-01-SC	Long-term Site Monitoring S	ystem	S&M	S,W,EU,F	Improved Site Monitoring and Surveillance System Resulting In Cost Reductions.	
CC = Cap	veillance and Monitoring s and Covers urface Science	PB = Physical Barrie Eco = Ecosystem Mo Tox = Toxicity	onitoring S F	/ = Water = Soil = Facilities U = Engineered Units	s Appendix A, Attachment B	

Need Code	Need Title	Category	Contaminate Site Type	ed Plain Language Non S&T
AL-09-02-02-SC	Environmental Restoration (ER) Site Hazard Inform System	nationIM	S,W,EU,F	Need to Develop An Information System to Ensure the Availability and Retreivability of Site Hazard Information In Real-time For Future Site Activities (including Emergency Response)
CH-SS04-99	Long-term Groundwater Monitoring	S&M	W	Need For Enhanced Or New Monitoring Techniques That Allow More Reliable, Quick and Inexpensive Groundwater Analysis.
ID-1.1.05	Detect Interactions Between Spent Nuclear Fuel and Storage Containers	d S&M,PB	EU	Technology Needed to Detect Corrosion of SNF and Storage Containers.
ID-6.1.02	Real-time Field Instrumentation For Characterization and Monitoring Soils and Groundwater.	on S&M	S,W	Rapid and Accurate Instrumentation Needed to Identify Groundwater and Soil Contamination, Concentrations to Compare With Risk-based Levels.
ID-6.1.27	Integrated Suite of In Situ Instruments to Determine Flux In the Vadose Zone.	s S&M,SS	S,W	Integrated Tools and Devices Are Needed to Directly Measure Contaminant Flux As Key Modeling Input to Improve Predictions.
ID-6.1.30	Instrumentation to Reliably Measure Soil Gas Flux Accounting For Barometric and Temporal Variation	S&M,SS as.	S	The Ability to Quantify the Affects of Natural Changes In Temperature and Barometric Pressure On the Movements of Organics In Soil.
ID-6.1.34	Improved Passive Vapor Extraction Technology.	SS	S,W	Better Understanding of Natural Changes In Temperature and Pressure That Affect Soil Gas Movement to Depths of 600 Feet Vs. the Current Capability of 20 Feet.
CC = Cap	veillance and Monitoring s and Covers urface Science  PB = Physical Barr Eco = Ecosystem N Tox = Toxicity	lonitoring S F	/ = Water = Soil = Facilities U = Engineered Units	S Appendix A, Attachment B

Need Co	de Need Title	Category	Contaminated Site Type	d Plain Language Non S&T
ID-S.1.01	Microbial Alteration of Heavy Metal Radionuclide Partitioning At Mineral		A	leed to Study Biological Processes That affect Mobility and Partitioning of Heavy Metals and Rad Contaminants.
ID-S.1.04	Real-time Field Instrumentation For Cand Monitoring Soils and Groundwate		D C	leed Is For Faster and Cheaper Detection Devices to Aid In Soil and Groundwater Characterization, Sampling and Monitoring of Contaminants Below Ground.
ID-S.1.09	Characterization of Scale and Spatial and Preferential Flow	Heterogeneity SS	F C V C	leed to Improve the Ability to Predict flow and Transport Modeling of contamination Below Ground. This Deals With the Uneven Distribution of contaminant Pathways and Our Ability to redict Preferential Flow.
ID-S.1.10	Geochemistry of Contaminants In the	Vadose Zone SS	Iı C	Jeed For Better Understanding of Interaction Between Geology and Contaminants Below Ground. Will Improve Movement Predictions.
ID-S.1.11	Modeling of Flow and Transport In the	ne Vadose Zone SS		mprove Modeling For Contaminant Movement Below Ground.
ID-S.1.12	Understanding the Behavior of Waste Their Near-field Transport	Forms and PB	N	Jeed to Improve Conceptual Models to More Accurately Estimate Releases From Contaminant Waste Forms.
ID-S.1.14	Transport of Contaminants In the Vap	oor Phase SS	0	better Understanding and Characterization of How Contaminants Move In the Soil oas Phase Below Ground.
Legend:	CC = Caps and Covers Eco = SS = Subsurface Science Tox =	Ecosystem Monitoring S Toxicity F	W = Water S = Soil F = Facilities EU = Engineered Units	Appendix A, Attachment B

Need Co	de	Need Title		Category	Contaminate Site Type	ed Plain Language	Non S&T
ID-S.1.15		Physics of Flow In the Vadose	2 Zone	SS		Need to Conduct Research to Improve C Ability to Quantify and Predict Contaminant Transport In Below Groun	
ID-S.1.16		Quantifying Uncertainty In Ri	sk Calculations	TOX		A Better Understanding of the Health Effects of Mixtures of Contaminants and Quantifying the Uncertainties of Health Effects Will Improve Risk Calculations.	i
ID-S.1.17		Development of Sensors For I Measurements In the Vadose 2 Variability.		S&M,SS		Need to Develop Indirect Sensors For L Volume Measurements For Things Like Moisture Content, Pressure and Contaminant Concentration to Enhance Modeling Capability.	
ID-S.1.18		Development of Indirect Sens. Spatial Variability Analyses o		S&M,SS	.,	A Method Is Needed to Obtain a Cost-effective Technique to Map Moiste Content, Pressure and Contaminant Concentration Between Boreholes Below Ground.	
ID-S.1.19		In Situ Biologic Activity Sens Groundwater Monitoring, Cha Remediation.		S&M,SS		Need to Develop Devices and Instrumer to Measure Biological Activity Far Belo Ground. Indicates Contaminant Decay t Predict Concentrations At Sites.	W
nv01-0001-01	1s	Down Hole Real Time Monito Tritium) In Boreholes	oring of Radiation(mainl	y S&M		An Instrument Is Needed to Perform Da Low-level Radiation Measurements In I Monitoring Wells. Other Needed Measurements Are Temperature, pH, Electrical Conductivity, Water Level, an Total Gamma.	Deep
Legend:	S&M = Surveil CC = Caps a SS = Subsurfa		PB = Physical Barrier Eco = Ecosystem Mor Tox = Toxicity	nitoring S I	N = Water S = Soil F = Facilities EU = Engineered Units	Appendix A, Attachment	3

Need Code	Need Title	Category	Contaminate Site Type	ed Plain Language Non S&T
nv02-0001-02S	Deep Well Sampling	S&M	W	A Cost-effective Well Design and Sampling Technology Is Needed For Sampling Groundwater For Radionuclides and Other Physical and Chemical Parameters In Deep (up to 1,500 Meters) Wells In Remote Areas.
nv11-0001-08	Long Term Management of Void Space, Containers, and Cover Subsidence Disposed Waste	CC	EU	Methods Need to Be Developed to Better Predict the Dynamics of Collapse of Void Space, Container/waste Form Degradation, and Subsidence of Cap Materials.
nv12-0001-06	Long Term, Flexible Arid Site Closure Cover	CC	EU	Development of a Long-lasting, Cost-effective Closure Caps For Desert Conditions Like Those At NTS Is Needed.
nv18-0001-07S	Optimizing Monitoring of Contaminant Transport an Subsidence In the Vadose Zone of Low Level Radioactive Waste Sites	d S&M	S,W,EU,F	Need to Develop Systems That Can Verify Site Conditions and Provide An Early Warning of the Rate of Transport of Waste Contaminants Along Transport Pathways.
ods-int-gjpo-1.1	Noxious Weed Control	S&M	S	Need to Develop More Cost Effective, Long Term Noxious Weed Control Methods.
ods-int-gjpo-1.2	Long-life Signage	S&M,PB	EU	Need For Improved, More Durable Signs That Are More Resistant to Weather and Vandalism.
ods-int-gjpo-1.3	Ways to Strengthen Physical Or Institutional Control	ls PB	EU	Need For Improved Physical Barriers and Intrusion Prevention Systems.
CC = Caps	reillance and Monitoring B = Physical Barrie Eco = Ecosystem Monitoring Eco = Toxicity	onitoring S F	V = Water 5 = Soil 5 = Facilities 5 = Engineered Unit	s Appendix A, Attachment B

Need Co	de I	Need Title		Category	Contaminate Site Type	ed Plain Language No	on S&T
ods-int-gjpo-l	1.4	Down-hole Monitors		S&M	S,W	Need to Develop An In-situ Monitoring Device That Can Analyze and Transmit the Data Remotely.	
ods-int-gjpo-1	1.5	Ways to Measure Moisture Flo	ows In Caps	S&M,CC	EU	Need to Develop a More Cost Effective, Remotely Operated Device to Measure Moisture In/under Caps and Covers.	
ods-int-id-1.3		Capability to Monitor Contami Structures	nant Movement Within	S&M	EU,F	There Is a Need For the Capability to Monitor Structures, Both Internally and Externally, to Ensure Migration of Contaminants Is Not Occurring and/or to Provide Early Detection.	
ods-int-id-1.4		Policy For Determining Level Control	of Security For Access			A Policy Is Needed to Determine the Level of Security (Access Control) Required For An Entombed Facility/structure.	x
ods-int-id-1.5	6	Uniform DOE Policy For Stak	eholder Issues			Need For a National Policy That Addresses Stakeholder Concerns About Entombment/D&D Practices That Apply to All Sites Uniformly.	x
ods-int-id-10.	3	Real Time Detection of Below	Ground Releases	S&M	S,W	Need to Develop a Real Time Sensor Device to Detect Below Ground Leaks, Spills, Or Releases of Contaminants Before Reaching Ground/surface Water.	
ods-int-id-10.	4	Embedded Monitoring Devices	s Or Sensors	S&M	F	Need to Develop An Embedded Device to Detect Contamination Releases In High Level Waste Tanks and Storage Structures That Have Been Remediated.	
Legend:	S&M = Surveil CC = Caps at SS = Subsurfa		PB = Physical Barriers Eco = Ecosystem Mor Tox = Toxicity	nitoring S F	/ = Water = Soil = Facilities U = Engineered Units	s Appendix A, Attachment B	

Need Code	Need Title	Category	Contaminate Site Type	ed Plain Language Non S&T
ods-int-id-2.1	Better Surveying and Monitoring Devices	S&M	S,F,EU	A Need For Improved Contaminant Monitoring Below a Facility Left In Place and a Method to Detect Possible Subsidence of Capped Engineered Units.
ods-int-id-2.2	More Durable Sensors to Monitor Contaminant Movement	S&M	S,W	A Need to Develop More Durable Sensors to Monitor Contaminant Movement Below Structures.
ods-int-id-3.1	In-situ Samplers to Detect Contaminant Movement	S&M	S,W	A Need For In-situ Samplers That Can Detect and Send Data Remotely, With Little/no Human Intervention.
ods-int-id-4.1	Long-term Information and Records Management System	IM	S,W,EU,F	Need For Long-term Records Management System.
ods-int-id-5.2	Method to Monitor Impacts of Changes On Modeli Requirements and Toxicity Data	ng		Need Method to Monitor the Impacts of Changes On Modeling Requirements and Toxicity Data.
ods-int-id-6.1	Sensor Array In SDA to Detect Moisture Infiltration	n S&M	EU	Need to Develop a Sensor Array In the Soil Cover Over the Subsurface Disposal Area to Detect Moisture Infiltration.
ods-int-id-6.2	Reliable Monitoring Network For Groundwater	S&M	W	Need to Develop a Reliable Monitoring Network For Groundwater.
ods-int-id-6.3	Leachate Detection and Collection As a Backup	S&M	S,W	Need to Develop a Leachate
	System			Detection/collection Backup System In-situ.
ods-int-id-6.4	Improved Closure Cap Cover Design and Monitori System	ng CC	EU	Need to Design a Closure Cap/cover and Monitoring System to Maintain Integrity
				Over the Long Term.
CC = Cap	veillance and Monitoring PB = Physical Barı s and Covers Eco = Ecosystem I Tox = Toxicity	Monitoring S F	/ = Water = Soil = Facilities U = Engineered Units	s Appendix A, Attachment B

Need Code	Need Title		Category	Contaminate Site Type	ed Plain Language Non S&T
ods-int-id-7.1	Need to Monitor Groundwa	ter, Ecological Indicators	S&M	S,W,EU,F	Need to Monitor Groundwater, Ecological Receptors, Soil and Air (rad) Monitoring, Cap Integrity and Moisture, Plant and Animal Intrusion Into Caps.
ods-int-id-7.2	Need to Determine Cap Dur	rability	CC	EU	Need to Improve Cap Durability and a Better Understanding of Contaminant Retention Rates, Dispersivity, Plant Uptake Factors, Bio-accumulation Rates, Fracture Flow Rates, and Boundary Conditions.
ods-int-id-7.3	Better/cheaper Methods of G Samples	Collecting and Analyzing	S&M	S,W	A need For Real-time Monitoring and Alarms, (e.g., Inline Sensors For Nitrate At INTEC Effluent), Down-hole Sensors, and Real-time Monitoring For Air Contaminants. Need For Sensors to Measure Water Level In Wells (real Time). For Tritium, There Is A Need For Continuous Monitoring.
ods-int-id-7.4	Groundwater Monitoring U Transmission	sing Electronic Data	IM	S,W,EU,F	Need to Capture Groundwater Data, Unexploded Ordnance Locations, and General Records, and Official Records (including Log Books) In Perpetuity. Need For Comprehensive Site-wide Data Storage System.
ods-int-id-7.5	Ecological Monitoring, Dat	a Management	S&M	S,W	Need For Improved Ecological Monitoring Capabilities to Detect Subtle Changes In Ecological Indicators.
ods-int-id-7.6	Improved Well Integrity and	d Closure	S&M	W	Need For Improved Well Designs to Enhance Long Term Well Durability and Maintainability.
CC = C	Surveillance and Monitoring caps and Covers bsurface Science	PB = Physical Barrier Eco = Ecosystem Mo Tox = Toxicity	nitoring S F	/ = Water = Soil = Facilities U = Engineered Units	s Appendix A, Attachment B

Need Code	Need Title		Category	Contaminate Site Type	ed Plain Language Non S	S&T
ods-int-id-8.1	Sensors That Can Be Inserte	ed Into Grout	S&M	EU,F	Need to Develop In-situ Grout Integrity Sensors.	
ods-int-id-8.2	Ways to Quantify Moisture	In/under Caps	S&M,CC	EU,S	Need to Develop Capability to Quantify Moisture In and Under Covers/caps.	
ods-int-id-8.3	Probes For Isotopic Measur	ement	S&M	S,W,EU	Need a Device to Measure Radio-isotopes In-situ.	
ods-int-ws-1.1	Embedded Radon Sensor		S&M	S,EU	Need For a Below Ground Monitor/sensor Device to Detect Radon At the Top of the Radon Barrier Instead of At the Surface of the Cap.	
ods-memo-id-1.1	Cost Effective Methods For Surveillance	LTS Monitoring and	S&M	S,W,EU,F	The Need to Evaluate the Use of In-situ Analyical Techniques Or Remote Monitoring to Replace Current Techniques of Sampling and Analysis to Reduce Costs.	
ods-memo-id-1.2	Reliable Risk Assessment M Transport Modeling to Supp		SS	S,W	A Need to Reduce the Uncertainty In Risk Predictions to Decrease the Cost of Stewardship Activities.	
ods-memo-id-1.3	Methods to Support the Inte Management With LTS	gration of Land			Need to Evaluate the Impact of End-State Decisions On Future Land-use Options.	X
ods-memo-id-1.4	Engineering Solutions For I Residual Contamination and		PB,CC	EU,F	Need For a Better Understanding of Long-term Performance of Engineered Solutions.	
CC = Ca	rveillance and Monitoring ps and Covers surface Science	PB = Physical Barrier Eco = Ecosystem Mo Tox = Toxicity	nitoring S F	/ = Water = Soil = Facilities U = Engineered Unit	s Appendix A, Attachment B	

Need Code	Need Title	Category	Contaminate Site Type	ed Plain Language Non S&T
ods-memo-id-1.5	Strong Cost Estimating Tools For LT	ΓS		A Need For Better Tools For Defensible x Life-cycle Cost Estimates For LTS.
ods-memo-id-1.6	Tools For the Management For Infor Generations	rmation of Future IM	S,W,EU,F	Need to Develop Tools to Ensure Information Management and Transfer to Future Generations.
ods-memo-oh-1.1	Long Term Record Keeping and Reta	rievability IM	S,W,EU,F	Need to Develop a Record Keeping System That Is Easily Accessed and Maintained.
ods-memo-oh-1.10	Remote Sensing and Monitoring of V	Vegetation S&M	EU,S	Need to Develop Remote Sensing Technology to Monitor Long Term Health of Vegetation On Disposal Facility Covers and Ecosystem.
ods-memo-oh-1.11	Integrated Real Time Sensor and Dat System	ta Transmission S&M	S,W,EU,F	Need to Develop Integrated System to Collect, Store and Transmit Data In Real Time.
ods-memo-oh-1.12	Automated X-ray System to Examine	e Disposal Cell S&M	EU	Need to Develop Automated System to Examine Contents of Disposal Cell Post Closure.
ods-memo-oh-1.13	Real-time Leachate Detection and M System	Ieasurement S&M	EU	Need to Develop a Real-time, Monitoring and Sensing System to Determine the Integrity of Leachate Collection Systems and Detect Leaks In Collection System Lines.
ods-memo-oh-1.14	Passive Treatment of Leachate	S&M	EU	Need to Develop a Process For the Passive Treatment of Leachate.
CC = Caps	and Covers Eco :	= Ecosystem Monitoring S = Toxicity F	= Water = Soil = Facilities J = Engineered Units	s Appendix A, Attachment B

Need Code	Need Title		Category	Contaminate Site Type	ed Plain Language	Non S&T
ods-memo-oh-1.2	Leachate Collection and Tran Maintenance	nsmission Line	S&M	EU	Need to Develop Automated Technolog to Unplug Leachate Collection and Transmission Lines.	y
ods-memo-oh-1.3	Automated Security System				Need to Develop An Automated Securit System.	y <b>x</b>
ods-memo-oh-1.4	Perimeter Groundwater Well	Monitoring	S&M	W	Need to Develop Automated Technolog to Monitor Perimeter Groundwater Wells to Determine Elevation of Water, Detect Contaminants, Etc.	y
ods-memo-oh-1.5	Monitoring Biological/chemiand Streams (Paddy's Run)	cal Properties of Ponds	S&M	S,W	Need to Develop Automated Method Fo Monitoring Biological and Chemical Properties of Ponds and Streams (Paddy Run)	
ods-memo-oh-1.6	Automated Meteorological M	Ionitoring Stations	S&M	AIR	Need to Construct Real Time Automated Meteorological Monitoring Stations.	i
ods-memo-oh-1.7	Disposal Facility Physical Ch	nange Monitoring System	S&M,PB	EU,F	Need to Develop Technology to Measur Physical Changes and Differential Subsidence In Disposal Facilities.	e
ods-memo-oh-1.8	Detection of Penetrations In I	Disposal Facilities	S&M,PB	EU,F	Need to Develop Automated Method to Detect Penetrations Or Intrusions of Water/moisture Or Groundwater Into Disposal Facilities.	
ods-memo-oh-1.9	Detection of Erosion and Rur	noff	S&M	S,W	Need to Develop Automated Technolog to Detect, Measure and Monitor Erosion and Runoff From Remediated Areas and Disposal Facilities.	
CC = Caps	veillance and Monitoring s and Covers urface Science	PB = Physical Barrier Eco = Ecosystem Mor Tox = Toxicity	nitoring S F	V = Water S = Soil F = Facilities EU = Engineered Units	s Appendix A, Attachment I	3

Need Co	ode Need Title		Category	Contaminate Site Type	ed Plain Language Nor	n S&T
ods-rep-2	LTS Data and Information the Working Draft	Management Needs From	IM	S,W,EU,F	There Is a Need For LTS Data Standards For Storage and Use.	
ods-rep-3.1	Better Tools For In-situ Fie	eld Measurement	S&M,SS	S,W	Identifies the Need For Better Tools (e.g., In-situ Field Measurement) to Characterize and Accurately Predict (model) Contamination Movement Below Ground.	
ods-rep-3.2	Improved Interagency Cook	rdination			Need For Improved Interagency Coordination Among 18 Specific Research Programs On Hazardous Chemicals and Heavy Metals Directly Related to EM Science Program and DOE Cleanup.	x
ods-rep-3.3	Long-term Emphasis of Re	search Focus			EM Science Program Should Emphasize Four Research Areas: (1) Characterization of Subsurface Contaminants and the Subsurface, (2) Conceptual Modeling, (3) Containment and Stabilization, (4) Monitoring and Validation.	x
ods-rep-3.4	Methods to Validate Conta	inment and Stabilization	РВ	EU,F	A Need For Methods to Validate Containment and Stabilization Systems to Ensure Long-term Protection.	
ods-rep-3.5	Methods For Designing Mo Current Conditions and Ch		S&M	S,W,EU,F	Need to Develop Methods For Designing Monitoring Systems to Detect Both Current Conditions and Changes In System.	
ods-rep-3.6	Research Dealing With Tra Involving Metals and Radio				Need Specific Research Dealing With Transuranic Contaminants Involving Metals and Radionuclides.	X
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Mon Tox = Toxicity	nitoring S F	V = Water S = Soil F = Facilities EU = Engineered Units	s Appendix A, Attachment B	

Need Co	ode Need Title		Category	Contaminate Site Type	ed Plain Language No	on S&T
ods-rep-3.7	Integration of Research Cor Community of Researchers	nmunity to Broaden			Need to Integrate Research From Government Agencies With Research Capabilities, National Laboratories, Universities, and Industry.	x
ods-rep-4.1	Develop Integrated Solution and Future Technologies	With Regards to Present			Need to Identify Present and Future Subsurface Technologies, Technology Gaps, and Combining Them For An "Integrated Solution."	x
ods-rep-4.2	Full Capabilities of Vadose Prediction, and Monitoring	Zone Characterization,	SS	S,W	A Better Understanding of Below Ground Characterization, Prediction, and Monitoring.	
ods-rep-4.3	Better Analysis and Assessi Repository Sites	nent Stages For	PB	EU	Need For An Improved Repository Design That Creates No Undue Future Risks.	
ods-rep-4.4	Validation Data Through M	odel Adjustments	SS	S,W	A Need For Site Characterization Data to Validate Model Predictions.	
ods-rep-4.5	Need For Predicting Contar the Vadose Zone	ninant Transport Through	SS	S,W	Need to Predict Contaminant Transport Below Ground Using a Three-step Iterative Process.	
ods-rep-4.6	Field Scale Research		SS	S,W	Need to Use Field Data Gathered Over Long Periods of Time to Accurately Predict Contaminant Movement and Behavior.	
ods-rep-4.7	Ambient Monitoring, Performance Detection Monitoring	mance Monitoring and	S&M	S,W,EU,F	A Complete Long Term Monitoring System Includes the Need For Ambient, Performance, and Detection Monitoring.	
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Mon Tox = Toxicity	itoring S F	V = Water 5 = Soil 5 = Facilities 5U = Engineered Units	s Appendix A, Attachment B	

Need Code	Need Title	Cate	-	Contaminate Site Type	d Plain Language	Non S&T
ods-rep-8-nm-1.1	Cost Effective Monitoring and Surv Techniques	veillance S&M	М		Need For Improved, Cost Effective, Monitoring and Surveillance Techniques	
ods-rep-8-tn-1.1	Enhanced Reliability of Engineered	Controls PB		]	Need For Improved Ability to Predict and Assess Long-term Performance of Engineered Controls (Isolation Caps and Trenches, Reactive Barriers, etc) and Monitoring Systems.	
ods-rep-8-tn-1.3	Remote Monitoring Techniques	S&M	м,сс	(	the Need For Remote Monitoring of Cap Covers and Trenches to Detect Failures, Possibly Using Satellite Technology.	s,
ods-rep-8-tn-1.5	Insitu Biological Monitoring to Rep Monitoring	place Analytical S&M	М	;	Need For Insitu Biological Monitoring to Supplement and Eventually Replace Traditional Analytical Monitoring.	
ods-rep-emsp-1.1	Contaminant Monitors and Diagnos	stic Parameters S&M	М	]	Need to Develop Improved Sensors and Define Diagnostic Parameters to Identify and Characterize the Presence of Contaminants In All Media.	
ods-rep-emsp-1.2	Sensors to Monitor Physical Integrit Structures and Landfills	ty of Barriers, S&M	м,РВ	1	Need to Develop Improved Sensors to Monitor Physical Integrity of Barriers, Structures and Landfills Post-closure.	
ods-rep-emsp-1.3	Remote Sensing of Ecosystems	S&M	м,ЕСО	(	Need to Develop Improved Remote Sens of Ecosystem Indicators Including Vegetation.	ing
oh-f048	Long-term Monitoring of Caps and	Covers S&M	М,СС	]	Need to Identify Improved Long-term Monitoring of the On-Site Disposal Facility Cover System.	
CC = Caps	and Covers Eco	= Physical Barriers = Ecosystem Monitoring = Toxicity	S = S F = F	Water Soil Facilities Engineered Units	Appendix A, Attachment B	i

Need Co	de Need Title		Category	Contaminate Site Type	ed Plain Language Non S&T
oh-f052	Long-term Treatment and M	Ionitoring of Leachate	S&M	EU	Need For a Stand-alone System to Detect and Treat Leachate After All Other Operating Systems Are Shut Down.
ORBW-08	Long-term Performance Ass	essments	SS	S,W,EU,F	Improved Predictive Capabilities For Long-term Performance Assessments Are Needed to Ensure Long-term Reliability.
ORHY-06	Fractured Media Flow Chara	acterization	SS	S,W	Technologies Are Needed to Predict Fracture Networks, Groundwater Flow and Contaminant Transport Below Ground.
ORHY-21	Real Time Performance Ass	essment Monitoring	S&M	S,W	Technologies For Real-time, In Situ Monitoring of Groundwater and Surface Water.
ORHY-21A	Real Time Performance Ass	essment Monitoring	S&M	S,W	Technologies For Real-time, In Situ Monitoring of Groundwater and Surface Water (Paducah).
RF-SNM18	Core Scientific R&D Capab Nuclear Material Manageme				Need For Retention of Scientific Expertise x (Chemistry and Physics) Related to Safety and Health Issues For Stabilization and Storage of Nuclear Materials.
RL-DD052	Long-term Monitoring Arou Facility For CDI	nd and Under the 221-U	S&M	S,W	Technologies Are Needed to Monitor Contaminants In the Soil Around and Under the 221-U Facility to Verify That Contaminants Are Being Contained Now and In the Future.
RL-SS24-S	Detection/distribution of Co Binding On Site-specific Mi		SS	S,W	Research Is Needed to Characterize the Chemical Composition of Microbially-produced, Metal-binding Molecules.
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Mor Tox = Toxicity	nitoring S F	= Water = Soil = Facilities J = Engineered Units	s Appendix A, Attachment B

Need Co	ode Need Title	ı	Category	Contaminate Site Type	ed Plain Language Non S&T
RL-SS25-S	Detection/distribution of C Form and Mobility of Dens Liquids In Hanford Subsur	se, Non-aqueous Phase	SS		Better Understanding of Chemical Form and Mobility of Dense, Non-aqueous Phase Liquids (DNAPLs) Below Ground.
RL-SS26-s	Transport of Contaminants Contaminant Species and C Groundwater		SS	,	Determine How and How Fast Contaminants Change Chemical Form and/or Interact With Minerals (e.g., Carbonates) in Soil.
RL-SS27	Use of Field Data From Re Elucidate Controlling Feat Contaminant Distribution		SS		Need to Investigate Field Sites to Develop A Better Understanding of Physical and Chemical Processes That Affect Contaminant Distribution Thereby Increasing Confidence In Predicting Contaminant Travel Times.
RL-SS27-s	Transport of Contaminants and Biogeochemical React In Hanford Subsurface	- Rate of Coupled Abiotic ions Involving Contaminants	SS		A Better Understanding of the Chemical and Biological Interactions That Affect Contaminant Movement Below Ground.
RL-SS28	Understand, Quantify and Reactions and Interactions Concern and Vadose Zone	Between Contaminants of	SS		A Better Understanding of Why Contaminants Become More Or Less Mobile With Longer Contact Times, and the Physical, Chemical, and Biological Causes of Such Changes and How They Are Appropriately Modeled.
RL-SS28-s	Transport of Contaminants Formation and Colloidal T In Site-specific Groundwat	ransport of Contaminants	SS	,	Need to Determine the Mechanisms and Rates of Production of Inorganic and Organic Colloids In Groundwater, the Rates of Adsorption of Contaminants Onto Colloids, and the Effect of Colloid-facilitated Transport On Contaminant Migration.
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity	toring S : F :	= Water = Soil = Facilities J = Engineered Units	Appendix A, Attachment B

Need Co	de Need Title	Catego	ry Contaminate Site Type	ed Plain Language Non S&T
RL-SS29	Develop Descriptions of Contam Transport In the Vadose Zone	inant Flow and SS	S,W	Need to Improve the Modeling of Below Ground Contaminant Movement By Including Additional Processes (e.g., the Coupling of Physical and Chemical Processes), With Finer Grids and Time Spacings, For Better Simulation.
RL-SS29-s	Transport of Contaminants - Effe Heterogeneities On Chemical Re		S,W	Need to Develop Detection Methods That Provide Adequate Signal Penetration and Reflection/refraction and Account For Sediment Moisture, Grain Size, and Clay Content. Science Is Needed to Determine Chemical Information In Situ As Well.
RL-SS30	Understand and Quantify Water I Vadose Zone Using Uncontaminates		S,W	Better Understanding of the Nature and Extent of Preferred Flow Paths Below Ground Along With a Determination of Which Physical Features and Moisture Conditions Affect the Preferred Flow Paths Is Needed.
RL-SS30-s	Transport of Contaminants - Ren Cesium Beneath Waste Tanks	nedial Technology For SS	S,W	A Need For An Improved Understanding of the Chemical Processes Affecting Cesium Transport Below Ground In Conjunction With HLW Tank Liquids.
RL-SS31-s	Remediation - Mathematical Form Reaction/material Transport	mulations of Chemical SS	S,W	A Need For Better Computational Tools to Address a Wide Range of Chemical Reactions, and Reaction Rates.
RL-SS32	Understand and Quantify the Rel Contaminant Sources, Vadose Zo and Groundwater Plume Properti Boundaries With a Focus On the	one Plume Properties les At Hydrologic	S,W	Better Understand the Behavior of Contaminants At the Water Table Boundary.
Legend:	CC = Caps and Covers E SS = Subsurface Science T	B = Physical Barriers co = Ecosystem Monitoring ox = Toxicity	W = Water S = Soil F = Facilities EU = Engineered Units	s Appendix A, Attachment B

Need Co	ode Need Title	1	Category	Contaminate Site Type	ed Plain Language Non S&T
RL-SS32-s	Remediation - Reactivity of C Subsurface	Organics In the Hanford	SS		Better Understanding of the Biodegradation of Halogenated Organic Compounds and Metal/radionuclide Organic Constituents.
RL-SS33	Techniques to Delineate Gro Dimensions and Define a Sci Addressing Scaling Issues In	entific Basis For	SS		Better Understand How to Incorporate Three-dimensional Properties of Contaminated Groundwater and Regional-scale Data Into Predictions of Contaminant Concentration and Distribution.
RL-SS33-s	Remediation - Interaction of Hanford Subsurface	Remedial Processes With	SS	,	Need to Measure Reaction Rates of Contaminants Being Remediated and Those Solids, Liquids, and/or Gases Introduced As Part of Remedial Action.
RL-SS34	Understand, Quantify and De Biogeochemical Reactions at Contaminants of Concern and Describe Biochemical Reacti	nd Interactions Between d Aquifer Sediments to	SS		A Better Understanding Is Needed of the Chemical, Physical, and Biological Processes That Affect the Long-term Behavior of Contaminants As They Enter the Aquifer and During Transport to the River.
RL-SS35	Technologies to Quantify the From Hanford Groundwater		SS		Better Understanding of How Contaminants Move to the River (Shoreline, Bed of the River, and How Far Out Into the River), and How Discharges Are Affected By Daily and Seasonal Variations of the River Flows.
RL-SS35-S	Monitoring of Contaminants Surrogates For Contaminants		SS		Need to Identify An Easy-to-measure Substitute Chemical As An Estimator For a Hard-to-measure Contaminant.
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity	toring S : F :	= Water = Soil = Facilities J = Engineered Units	Appendix A, Attachment B

Need Co	ode Need Title	Ca	ategory	Contaminate Site Type	d Plain Language N	lon S&T
RL-SS36	Provide Means to Integrate Reg Into Assessments of Contamina Impacts Within the Columbia F	ant Transport and	SS		A Need to Model and Understand Regional Effects of Chemical and Physical Components On Contaminant Movement to River Systems.	
RL-SS37	Provide Methodology to Relate From Sitewide-scale Groundwa the Various Scales Associated V In the River Environment	ater Flow Modeling to	S		A Need to Develop Transport Models to Quantify the Changes In Groundwater Characteristics, Flow Path, and Mathematical Computations For Estimating Contaminant Concentrations In the River.	7
RL-SS37-S	Monitoring of Contaminants - Orinciples	Chemical Sensor S	S,S&M		A Better Understanding of the Physics and Chemistry That Will Lead to More Accurate and More Sensitive Measurement of Contaminant Concentrations.	s
RL-SS38	Understand, Quantify and Deve Transport and Transformation of Groundwater-derived Contamin River	of	S,S&M		Develop a System (techniques/equipment/instrumentation) to Measure Chemical, Physical, and Biologica Parameters In the Area Between the Aquifer and the River, and to Validate and Verify Models.	al
RL-SS39	Understand and Provide Means Impacts of River Contamination		OX		Need to Develop Consistent Ways to Measure Impacts (Human, Ecological, Cultural, Socioeconomic) to Exposed Groups. Information Will Be Used to Determine Toxicity Benchmarks For the Decision-making Process.	
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Monitor Tox = Toxicity	ring S	= Water = Soil = Facilities J = Engineered Units	Appendix A, Attachment B	

Need Code	Need Title	Category	Contaminate Site Type	d Plain Language Non S&T
RL-SS40	Provide a Method to Develop Mass Bala Holistic) Inventory Estimates	ance (i.e., IM		There Is a Need For a Single and Consistent Inventory of the Discharges and Disposals of Radionuclides and Chemicals to the Surface and Subsurface.
RL-SS41	Understand and Quantify the Solubility of Contaminants of Concern At the Waste-Sediment Interface		:	A Better Understanding of Solubility of Certain Contaminants In Various Waste Matrices (e.g., Tc In Tank Waste) and How This Solubility Changes As the Waste Interacts With the Below Ground Sediments.
RL-WT017	Long-term Testing of Surface Barrier	PB,CC	-	There Is a Need For Better Understanding of Long-term Performance of Surface Barriers to Reduce Moisture Infiltration and Plant and Animal Intrusion.
RL-WT029	Data and Tools For Performance Assess	ments SS	· · · · · · · · · · · · · · · · · · ·	A Need For Better Estimates of Water Movement Through Buried Waste Over Long Periods In Arid Environments to Reduce Uncertainty of Models.
RL-WT035-S	Moisture Flow and Contaminant Transportations	ort In Arid SS	;	A Better Understanding of the Soil Physics and Retardation of Contaminants In Soils Under Natural Conditions Is Needed For Dose Calculations.
RL-WT043-S	Effect of Human and Natural Influences Water Distribution	On Long-term IM		A Need to Better Understand Long Term Land and Water Use At DOE Sites Considering Climate Change and the Ability to Incorporate Impacts of Those Changes Into Models to Predict the Movement of Contaminants.
CC = Cap		cosystem Monitoring S exicity F	= Water = Soil = Facilities J = Engineered Units	Appendix A, Attachment B

Need Cod	e Need Title	Catego	ory Contamina Site Type	ted Plain Language Non S&T
RL-WT044-S	Distribution of Recharge Rates	SS	S,W,EU	A Need to Quantify Distribution of Recharge Water Through the Waste Site and the Time Delay Through the Land Surface Into the Water Table.
RL-WT045-S	Vadose Zone Flow Simulation T Conditions	Fool Under Arid SS	S,W	Develop a Simulation Model to Predict the Movement of Contaminants Over Long Periods of Time In Arid Conditions.
SR00-1026	Reduce the Conservatism and To Associated With the Use of Lite (Kd) to Describe Radionuclide S In Performance Assessment Mo	rature Coefficients Sorption to Sediments	S,W	There Is a Need to Develop Alternative Concepts For Describing Contaminant Separation Beneath Radioactive Waste Disposal Facilities.
SR00-1030	Model Degradation In Cement E Saltstone) and Concrete Vault D Collapse		EU,F	There Is a Need to Develop a Model to Simulate the Degradation of Saltstone, a Cement-based Wasteform, and the Concrete Vaults Into Which It Is Emplaced Over Time Periods of Thousands of Years.
SR00-3027	Long Term Monitoring Technol	ogies S&M	S,W,EU,F	Need to Develop Insitu Remote Monitoring Technologies to Reduce the Cost of Data Collection Associated With Waste Sites.
SR00-4010	Characterization Data Managem	nent IM	S,W,EU,F	Need to Develop a Relational Database to Allow Storage and Retrieval of Comprehensive Data, Including Photos and Videos Related a D&D Project.
C	CC = Caps and Covers	PB = Physical Barriers Eco = Ecosystem Monitoring Fox = Toxicity	W = Water S = Soil F = Facilities EU = Engineered Uni	its Appendix A, Attachment B

#### **Attachment C -- Subsurface Science Needs**

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
AL-09-01-01-SC-S	Transport of HE and Metals In Fractured Rock and Surface Alluvial Systems	SS	S,W	Improved Understanding of the Movement of High Explosives (RDX) Components and Metal Contaminants (particularly Barium) Below Ground.
AL-09-01-06-SC-S	Issue of Scale In Flow Prediction and Contaminant Remediation In Porous Media	SS	S,W	Improved Ability to Predict Flow and Transport Below Ground That Captures the Large and Small Scale Physical Processes That Affect Water Movement.
AL-09-01-07-SC-S	Integration of Reactive Chemistry Into Field-scale Transport Models	SS	S,W	Improved Predictive Modeling Capabilities That Address Complex Chemical and Flow Processes.
AL-09-01-08-SC-S	Differences Between Saturated and Unsaturated Systems	SS	S,W	Contaminants Travel Differently In Wet and Dry Below Ground Environments. There Is a Need to Better Understand the Differences.
AL-09-01-10-SC-S	Physics of Fracture Flow and Transport In the Vadose Zone	SS	S,W	Better Understanding of the Importance of Cracks In Below Ground Water Movement Will Improve Models.
AL-09-01-11-SC-S	Water Fluxes and Solute Transport In Arid and Semiarid Environments	SS	S,W	Better Understanding of Water Movement Over Time and Area In Arid and Semi-arid Underground Environments, and Water Vapor Exchange At the Ground Surface.

S&M = Surveillance and Monitoring Legend: CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water S = Soil

F = Facilities

EU = Engineered Units

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Need Code	Need Title		Categor	y Contaminated Site Type	d Plain Language
AL-09-01-12-SC-S	Groundwater-surface Water I	nteractions	SS	S,W	Better Understanding of the Interaction Between Groundwater and Surface Water, I.e., What Affect Does Groundwater Pumping Have On Streamflow, and What Affect Does Surface Water Diversion Have On Groundwater Recharge.
AL-09-01-15-SC-S	Separation of Metals and Rac Uncontaminated Soils; Trans Radionuclides In Sediments a Systems	port of Metals and	SS	S,W	Better Understanding of the Separation and Movement of Metals and Radionuclides From Soils and Sediment.
ID-6.1.27	Integrated Suite of In Situ Ins Flux In the Vadose Zone.	struments to Determine	S&M,SS	S,W	Integrated Tools and Devices Are Needed to Directly Measure Contaminant Flux As Key Modeling Input to Improve Predictions.
ID-6.1.30	Instrumentation to Reliably M Accounting For Barometric a		S&M,SS	S	The Ability to Quantify the Affects of Natural Changes In Temperature and Barometric Pressure On the Movements of Organics In Soil.
ID-6.1.34	Improved Passive Vapor Extr	raction Technology.	SS	S,W	Better Understanding of Natural Changes In Temperature and Pressure That Affect Soil Gas Movement to Depths of 600 Feet vs. the Current Capability of 20 Feet.
ID-S.1.01	Microbial Alteration of Heav Radionuclide Partitioning At		SS	s,w	Need to Study Biological Processes That Affect Mobility and Partitioning of Heavy Metals and Rad Contaminants.
CC = Cap	veillance and Monitoring s and Covers urface Science	PB = Physical Barriers Eco = Ecosystem Mon Tox = Toxicity	itoring S F	N = Water S = Soil F = Facilities EU = Engineered Units	Appendix A, Attachment C

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
ID-S.1.09	Characterization of Scale and Spatial Heterogeneity and Preferential Flow	SS	S,W	Need to Improve the Ability to Predict Flow and Transport Modeling of Contamination Below Ground. This Deals With the Uneven Distribution of Contaminant Pathways and Our Ability to Predict Preferential Flow.
ID-S.1.10	Geochemistry of Contaminants In the Vadose Zone	SS	S,W	Need For Better Understanding of Interaction Between Geology and Contaminants Below Ground. Will Improve Movement Predictions.
ID-S.1.11	Modeling of Flow and Transport In the Vadose Zone	SS	S,W	Improve Modeling For Contaminant Movement Below Ground.
ID-S.1.14	Transport of Contaminants In the Vapor Phase	SS	S,W	Better Understanding and Characterization of How Contaminants Move In the Soil Gas Phase Below Ground.
ID-S.1.15	Physics of Flow In the Vadose Zone	SS	S,W	Need to Conduct Research to Improve Our Ability to Quantify and Predict Contaminant Transport In Below Ground.
ID-S.1.17	Development of Sensors For Large Scale Measurements In the Vadose Zone to Define Spatial Variability.	S&M,SS	S,W	Need to Develop Indirect Sensors For Large Volume Measurements For Things Like Moisture Content, Pressure and Contaminant Concentration to Enhance Modeling Capability.

S&M = Surveillance and Monitoring Legend:

CC = Caps and Covers SS = Subsurface Science PB = Physical Barriers Eco = Ecosystem Monitoring

S = Soil Tox = Toxicity F = Facilities

EU = Engineered Units

W = Water

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Need Code	e Need Title		Catego	ry Contamina Site Type	ated Plain Language
ID-S.1.18	Development of Indirect Sen Spatial Variability Analyses		S&M,SS	S,W	A Method Is Needed to Obtain a Cost-effective Technique to Map Moisture Content, Pressure and Contaminant Concentration Between Boreholes Below Ground.
ID-S.1.19	In Situ Biologic Activity Ser Groundwater Monitoring, Ch Remediation.		S&M,SS	S,W	Need to Develop Devices and Instruments to Measure Biological Activity Far Below Ground. Indicates Contaminant Decay to Predict Concentrations At Sites.
ods-memo-id-1.2	Reliable Risk Assessment M Transport Modeling to Suppo		SS	S,W	A Need to Reduce the Uncertainty In Risk Predictions to Decrease the Cost of Stewardship Activities.
ods-rep-3.1	Better Tools For In-situ Field	i Measurement	S&M,SS	S,W	Identifies the Need For Better Tools (e.g., In-situ Field Measurement) to Characterize and Accurately Predict (Model) Contamination Movement Below Ground.
ods-rep-4.2	Full Capabilities of Vadose 2 Prediction, and Monitoring	Zone Characterization,	SS	S,W	A Better Understanding of Below Ground Characterization, Prediction, and Monitoring.
ods-rep-4.4	Validation Data Through Mo	del Adjustments	SS	S,W	A Need For Site Characterization Data to Validate Model Predictions.
C	RM = Surveillance and Monitoring C = Caps and Covers S = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity		W = Water S = Soil F = Facilities	

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EU = Engineered Units

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Need Co	ode Ne	eed Title		Catego	•	Contaminated Site Type	d Plain Language
ods-rep-4.5		eed For Predicting Contamina e Vadose Zone	ant Transport Through	SS		S,W	Need to Predict Contaminant Transport Below Ground Using a Three-step Iterative Process.
ods-rep-4.6	Fie	eld Scale Research		SS		S,W	Need to Use Field Data Gathered Over Long Periods of Time to Accurately Predict Contaminant Movement and Behavior.
ORBW-08	Lo	ong-term Performance Assess	sments	SS		S,W,EU,F	Improved Predictive Capabilities For Long-term Performance Assessments Are Needed to Ensure Long-term Reliability.
ORHY-06	Fra	ractured Media Flow Characte	erization	SS		S,W	Technologies Are Needed to Predict Fracture Networks, Groundwater Flow and Contaminant Transport Below Ground.
RL-SS24-S		etection/distribution of Conta inding On Site-specific Miner		SS		S,W	Research Is Needed to Characterize the Chemical Composition of Microbially-produced, Metal-binding Molecules.
RL-SS25-S	Fo	Detection/distribution of Contaminants - Chemical Form and Mobility of Dense, Non-aqueous Phase Liquids In Hanford Subsurface		SS		S,W	Better Understanding of Chemical Form and Mobility of Dense, Non-aqueous Phase Liquids (DNAPL) Below Ground.
RL-SS26-S	Co	ransport of Contaminants - Roontaminant Species and Comroundwater		SS		S,W	Determine How and How Fast Contaminants Change Chemical Form and/or Interact With Minerals (e.g., Carbonates) In Soil.
Legend:	S&M = Surveillar CC = Caps and SS = Subsurface		PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity				Appendix A, Attachment C
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Need Co	ode Need Title		Category	Contaminated Site Type	l Plain Language
RL-SS27	Use of Field Data From Repr Elucidate Controlling Feature Contaminant Distribution		SS	S,W	Need to Investigate Field Sites to Develop a Better Understanding of Physical and Chemical Processes That Affect Contaminant Distribution Thereby Increasing Confidence In Predicting Contaminant Travel Times.
RL-SS27-S	Transport of Contaminants - and Biogeochemical Reaction In Hanford Subsurface		SS	S,W	A Better Understanding of the Chemical and Biological Interactions That Affect Contaminant Movement Below Ground.
RL-SS28	Understand, Quantify and De Reactions and Interactions Bo Concern and Vadose Zone So	etween Contaminants of	SS	S,W	A Better Understanding of Why Contaminants Become More Or Less Mobile With Longer Contact Times, and the Physical, Chemical, and Biological Causes of Such Changes and How They Are Appropriately Modeled.
RL-SS28-S	Transport of Contaminants - Formation and Colloidal Transler In Site-specific Groundwater		SS	S,W	Need to Determine the Mechanisms and Rates of Production of Inorganic and Organic Colloids In Groundwater, the Rates of Adsorption of Contaminants Onto Colloids, and the Effect of Colloid-facilitated Transport On Contaminant Migration.
RL-SS29	Develop Descriptions of Con Transport In the Vadose Zone		SS	S,W	Need to Improve the Modeling of Below Ground Contaminant Movement By Including Additional Processes (e.g., the Coupling of Physical and Chemical Processes), With Finer Grids and Time Spacings, For Better Simulation.
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Monit Tox = Toxicity	oring S = F =	Water Soil Facilities = Engineered Units	Appendix A, Attachment C
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Need Cod	de Need Title		Category	Contaminated Site Type	l Plain Language
RL-SS29-S	Transport of Contaminants - Heterogeneities On Chemica		SS	S,W	Need to Develop Detection Methods That Provide Adequate Signal Penetration and Reflection/refraction and Account For Sediment Moisture, Grain Size, and Clay Content. Science Is Needed to Determine Chemical Information In Situ As Well.
RL-SS30	Understand and Quantify W Vadose Zone Using Unconta		SS	S,W	Better Understanding of the Nature and Extent of Preferred Flow Paths Below Ground Along With a Determination of Which Physical Features and Moisture Conditions Affect the Preferred Flow Paths Is Needed.
RL-SS30-S	Transport of Contaminants - Cesium Beneath Waste Tanl		SS	S,W	A Need For An Improved Understanding of the Chemical Processes Affecting Cesium Transport Below Ground In Conjunction With HLW Tank Liquids.
RL-SS31-S	Remediation - Mathematical Reaction/material Transport		SS	S,W	A Need For Better Computational Tools to Address a Wide Range of Chemical Reactions, and Reaction Rates.
RL-SS32	Understand and Quantify the Contaminant Sources, Vado and Groundwater Plume Pro Boundaries With a Focus On	se Zone Plume Properties perties At Hydrologic	SS	S,W	Better Understand the Behavior of Contaminants At the Water Table Boundary.
RL-SS32-S	Remediation - Reactivity of Subsurface	Organics In the Hanford	SS	S,W	Better Understanding of the Biodegradation of Halogenated Organic Compounds and Metal/radionuclide Organic Constituents.
•	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity	toring S = F =	= Water = Soil : Facilities   = Engineered Units	Appendix A, Attachment C
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Need Co	ode Need Title		Category	Contaminated Site Type	l Plain Language
RL-SS33	Techniques to Delineate Gro Dimensions and Define a So Addressing Scaling Issues In	ientific Basis For	SS	S,W	Better Understand How to Incorporate Three-dimensional Properties of Contaminated Groundwater and Regional-scale Data Into Predictions of Contaminant Concentration and Distribution.
RL-SS33-S	Remediation - Interaction of Hanford Subsurface	Remedial Processes With	SS	S,W	Need to Measure Reaction Rates of Contaminants Being Remediated and Those Solids, Liquids, and/or Gases Introduced As Part of Remedial Action.
RL-SS34	Understand, Quantify and D Biogeochemical Reactions a Contaminants of Concern ar Describe Biochemical React	nd Interactions Between d Aquifer Sediments to	SS	S,W	A Better Understanding Is Needed of the Chemical, Physical, and Biological Processes That Affect the Long-term Behavior of Contaminants As They Enter the Aquifer and During Transport to the River.
RL-SS35	Technologies to Quantify th From Hanford Groundwater		SS	S,W	Better Understanding of How Contaminants Move to the River (Shoreline, Bed of the River, and How Far Out Into the River), and How Discharges Are Affected By Daily and Seasonal Variations of the River Flows.
RL-SS35-S	Monitoring of Contaminants Surrogates For Contaminant		SS	S,W	Need to Identify An Easy-to-measure Substitute Chemical As An Estimator For a Hard-to-measure Contaminant.
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Monit Tox = Toxicity	toring S = F =	= Water = Soil = Facilities J = Engineered Units	Appendix A, Attachment C

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
RL-SS36	Provide Means to Integrate Regional-scale Phenomena Into Assessments of Contaminant Transport and Impacts Within the Columbia River.	SS	S,W	A Need to Model and Understand Regional Effects of Chemical and Physical Components On Contaminant Movement to River Systems.
RL-SS37	Provide Methodology to Relate Information Derived From Sitewide-scale Groundwater Flow Modeling to the Various Scales Associated With Assessing Impacts In the River Environment	SS	S,W	A Need to Develop Transport Models to Quantify the Changes In Groundwater Characteristics, Flow Path, and Mathematical Computations For Estimating Contaminant Concentrations In the River.
RL-SS37-S	Monitoring of Contaminants - Chemical Sensor Principles	SS,S&M	S,W	A Better Understanding of the Physics and Chemistry That Will Lead to More Accurate and More Sensitive Measurements of Contaminant Concentrations.
RL-SS38	Understand, Quantify and Develop Descriptions of Transport and Transformation of Groundwater-derived Contaminants of Concern In the River	SS,S&M	S,W	Develop a System (techniques/equipment/instrumentation) to Measure Chemical, Physical, and Biological Parameters In the Area Between the Aquifer and the River, and to Validate and Verify Models.
RL-SS41	Understand and Quantify the Solubility of Contaminants of Concern At the Waste-Vadose Zone Sediment Interface	SS	S,W	A Better Understanding of Solubility of Certain Contaminants In Various Waste Matrices (e.g., Tc In Tank Waste) and How This Solubility Changes As the Waste Interacts With the Below Ground Sediments.

Legend: S&M = Surveillance and Monitoring

CC = Caps and Covers SS = Subsurface Science PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water S = Soil F = Facilities

EU = Engineered Units

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Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
RL-WT029	Data and Tools For Performance Assessments	SS	S,W,EU	A Need For Better Estimates of Water Movement Through Buried Waste Over Long Periods In Arid Environments to Reduce Uncertainty of Models.
RL-WT035-S	Moisture Flow and Contaminant Transport In Arid Conditions	SS	S,W	A Better Understanding of the Soil Physics and Retardation of Contaminants In Soils Under Natural Conditions Is Needed For Dose Calculations.
RL-WT044-S	Distribution of Recharge Rates	SS	S,W,EU	A Need to Quantify Distribution of Recharge Water Through the Waste Site and the Time Delay Through the Land Surface Into the Water Table.
RL-WT045-S	Vadose Zone Flow Simulation Tool Under Arid Conditions	SS	S,W	Develop a Simulation Model to Predict the Movement of Contaminants Over Long Periods of Time In Arid Conditions.
SR00-1026	Reduce the Conservatism and Technical Uncertainty Associated With the Use of Literature Coefficients (Kd) to Describe Radionuclide Sorption to Sediments In Performance Assessment Modeling.	SS	S,W	There Is a Need to Develop Alternative Concepts For Describing Contaminant Separation Beneath Radioactive Waste Disposal Facilities.

Legend: S&M = Surveillance and Monitoring

CC = Caps and Covers SS = Subsurface Science PB = Physical Barriers Eco = Ecosystem Monitoring Tox = Toxicity

S = Soil F = Facilities

W = Water

EU = Engineered Units

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# **Attachment D -- Surveillance and Monitoring Needs**

Need Cod	le Need Title		Catego	ry Contaminate Site Type	d Plain Language
AL-00-01-04-5	Long-term Monitoring Stra Evaluate the Design of Mat Engineered Covers		S&M,CC	EU	Improved Methods of Monitoring the Performance Or Stability of Engineered Caps Or Covers; Cost Savings Is a Goal.
AL-09-02-01-S	SC Long-term Site Monitoring	System	S&M	S,W,EU,F	Improved Site Monitoring and Surveillance System Resulting In Cost Reductions.
ch-ss04-99	Long-term Groundwater M	onitoring	S&M	W	Need For Enhanced Or New Monitoring Techniques That Allow More Reliable, Quick and Inexpensive Groundwater Analysis.
ID-1.1.05	Detect Interactions Betwee Storage Containers	n Spent Nuclear Fuel and	S&M,PB	EU	Technology Needed to Detect Corrosion of SNF and Storage Containers.
ID-6.1.02	Real-time Field Instrument and Monitoring Soils and C		S&M	S,W	Rapid and Accurate Instrumentation Needed to Identify Groundwater and Soil Contamination, Concentrations to Compare With Risk-based Levels.
ID-6.1.27	Integrated Suite of In Situ I Flux In the Vadose Zone.	nstruments to Determine	S&M,SS	S,W	Integrated Tools and Devices Are Needed to Directly Measure Contaminant Flux As Key Modeling Input to Improve Predictions.
ID-6.1.30	Instrumentation to Reliably Accounting For Barometric		S&M,SS	S	The Ability to Quantify the Affects of Natural Changes In Temperature and Barometric Pressure On the Movements of Organics In Soil.
_	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Mon Tox = Toxicity	itoring	W = Water S = Soil F = Facilities EU = Engineered Units	

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
ID-S.1.04	Real-time Field Instrumentation For Characterization and Monitoring Soils and Groundwater.	S&M	S,W	Need Is For Faster and Cheaper Detection Devices to Aid In Soil and Groundwater Characterization, Sampling and Monitoring of Contaminants Below Ground.
ID-S.1.17	Development of Sensors For Large Scale Measurements In the Vadose Zone to Define Spatial Variability.	S&M,SS	S,W	Need to Develop Indirect Sensors For Large Volume Measurements For Things Like Moisture Content, Pressure and Contaminant Concentration to Enhance Modeling Capability.
ID-S.1.18	Development of Indirect Sensing Instrumentation For Spatial Variability Analyses of State Variables	S&M,SS	S,W	A Method Is Needed to Obtain a Cost-effective Technique to Map Moisture Content, Pressure and Contaminant Concentration Between Boreholes Below Ground.
ID-S.1.19	In Situ Biologic Activity Sensor For Vadose Zone and Groundwater Monitoring, Characterization and Remediation.	S&M,SS	S,W	Need to Develop Devices and Instruments to Measure Biological Activity Far Below Ground. Indicates Contaminant Decay to Predict Concentrations At Sites.
nv01-0001-01s	Down Hole Real Time Monitoring of Radiation (Mainly Tritium) In Boreholes	S&M	W	An Instrument Is Needed to Perform Daily Low-level Radiation Measurements In Deep Monitoring Wells. Other Needed Measurements Are Temperature, pH, Electrical Conductivity, Water Level, and Total Gamma.

S&M = Surveillance and Monitoring Legend:

CC = Caps and Covers SS = Subsurface Science

Eco = Ecosystem Monitoring Tox = Toxicity

W = Water S = Soil F = Facilities

EU = Engineered Units

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PB = Physical Barriers

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
nv02-0001-02S	Deep Well Sampling	S&M	W	A Cost-effective Well Design and Sampling Technology Is Needed For Sampling Groundwater For Radionuclides and Other Physical and Chemical Parameters In Deep (up to 1,500 Meters) Wells In Remote Areas.
nv18-0001-07S	Optimizing Monitoring of Contaminant Transport and Subsidence In the Vadose Zone of Low Level Radioactive Waste Sites	S&M	S,W,EU,F	Need to Develop Systems That Can Verify Site Conditions and Provide An Early Warning of the Rate of Transport of Waste Contaminants Along Transport Pathways.
ods-int-gjpo-1.1	Noxious Weed Control	S&M	S	Need to Develop More Cost Effective, Long Term Noxious Weed Control Methods.
ods-int-gjpo-1.2	Long-life Signage	S&M,PB	EU	Need For Improved, More Durable Signs That Are More Resistant to Weather and Vandalism.
ods-int-gjpo-1.4	Down-hole Monitors	S&M	S,W	Need to Develop An In-situ Monitoring Device That Can Analyze and Transmit the Data Remotely.
ods-int-gjpo-1.5	Ways to Measure Moisture Flows In Caps	S&M,CC	EU	Need to Develop a More Cost Effective, Remotely Operated Device to Measure Moisture In/under Caps and Covers.

Legend: S&M = Surveillance and Monitoring

CC = Caps and Covers SS = Subsurface Science PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water S = Soil

F = Facilities

**EU = Engineered Units** 

Need Code	Need Title	Category	y Contaminated Site Type	Plain Language
ods-int-id-1.3	Capability to Monitor Contaminant Mo Structures	vement Within S&M		There Is a Need For the Capability to Monitor Structures, Both Internally and Externally, to Ensure Migration of Contaminants Is Not Occurring and/or to Provide Early Detection.
ods-int-id-10.3	Real Time Detection of Below Ground	Releases S&M		Need to Develop a Real Time Sensor Device to Detect Below Ground Leaks, Spills, Or Releases of Contaminants Before Reaching Ground/surface Water.
ods-int-id-10.4	Embedded Monitoring Devices Or Sens	sors S&M		Need to Develop An Embedded Device to Detect Contamination Releases In High Level Waste Tanks and Storage Structures That Have Been Remediated.
ods-int-id-2.1	Better Surveying and Monitoring Device	ees S&M		A Need For Improved Contaminant Monitoring Below a Facility Left In Place and a Method to Detect Possible Subsidence of Capped Engineered Units.
ods-int-id-2.2	More Durable Sensors to Monitor Conta Movement	aminant S&M		A Need to Develop More Durable Sensors to Monitor Contaminant Movement Below Structures.
ods-int-id-3.1	In-situ Samplers to Detect Contaminant	t Movement S&M		A Need For In-situ Samplers That Can Detect and Send Data Remotely, With Little/no Human Intervention.
CC = Caps		Ecosystem Monitoring S oxicity F	/ = Water = Soil = Facilities U = Engineered Units	

Need Code	Need Title		Category	Contaminated Site Type	d Plain Language
ods-int-id-6.1	Sensor Array In SDA to Det	ect Moisture Infiltration	S&M	EU	Need to Develop a Sensor Array In the Soil Cover Over the Subsurface Disposal Area to Detect Moisture Infiltration.
ods-int-id-6.2	Reliable Monitoring Networ	k For Groundwater	S&M	W	Need to Develop a Reliable Monitoring Network For Groundwater.
ods-int-id-6.3	Leachate Detection and Col System	lection As a Backup	S&M	S,W	Need to Develop a Leachate Detection/collection Backup System In-situ.
ods-int-id-7.1	Need to Monitor Groundwat	er, Ecological Indicators	S&M	S,W,EU,F	Need to Monitor Groundwater, Ecological Receptors, Soil and Air (rad) Monitoring, Cap Integrity and Moisture, Plant and Animal Intrusion Into Caps.
ods-int-id-7.3	Better/cheaper Methods of C Samples	Collecting and Analyzing	S&M	S,W	A Need For Real-time Monitoring and Alarms, (e.g., Inline Sensors For Nitrate At INTEC Effluent), Down-hole Sensors, and Real-time Monitoring For Air Contaminants. Need For Sensors to Measure Water Level In Wells (real Time). For Tritium, There Is a Need For Continuous Monitoring.
ods-int-id-7.5	Ecological Monitoring, Data	Management	S&M	S,W	Need For Improved Ecological Monitoring Capabilities to Detect Subtle Changes In Ecological Indicators.
CC = Ca	urveillance and Monitoring aps and Covers osurface Science	PB = Physical Barriers Eco = Ecosystem Mon Tox = Toxicity	itoring S = F =	= Water Soil Facilities = Engineered Units	

Need Code	Need Title		Category	Contaminate Site Type	d Plain Language
ods-int-id-7.6	Improved Well Integrity and	l Closure	S&M	W	Need For Improved Well Designs to Enhance Long Term Well Durability and Maintainability.
ods-int-id-8.1	Sensors That Can Be Inserte	d Into Grout	S&M	EU,F	Need to Develop In-situ Grout Integrity Sensors.
ods-int-id-8.2	Ways to Quantify Moisture	In/under Caps	S&M,CC	EU,S	Need to Develop Capability to Quantify Moisture In and Under Covers/caps.
ods-int-id-8.3	Probes For Isotopic Measure	ement	S&M	S,W,EU	Need a Device to Measure Radio-isotopes In-situ.
ods-int-ws-1.1	Embedded Radon Sensor		S&M	S,EU	Need For a Below Ground Monitor/sensor Device to Detect Radon At the Top of the Radon Barrier Instead of At the Surface of the Cap.
ods-memo-id-1.1	Cost Effective Methods For Surveillance	LTS Monitoring and	S&M	S,W,EU,F	The Need to Evaluate the Use of In-situ Analyical Techniques Or Remote Monitoring to Replace Current Techniques of Sampling and Analysis to Reduce Costs.
ods-memo-oh-1.10	Remote Sensing and Monito	oring of Vegetation	S&M	EU,S	Need to Develop Remote Sensing Technology to Monitor Long Term Health of Vegetation On Disposal Facility Covers and Ecosystem.
CC =	Surveillance and Monitoring Caps and Covers ubsurface Science	PB = Physical Barrier Eco = Ecosystem Mo Tox = Toxicity	nitoring S : F :	= Water = Soil = Facilities I = Engineered Units	

Need Cod	de	Need Title		Catego	_	Contaminated Site Type	l Plain Language
ods-memo-oh-	-1.11	Integrated Real Time Sensor a System	and Data Transmission	S&M		S,W,EU,F	Need to Develop Integrated System to Collect, Store and Transmit Data In Real Time.
ods-memo-oh-	-1.12	Automated X-ray System to E	Examine Disposal Cell	S&M		EU	Need to Develop Automated System to Examine Contents of Disposal Cell Post Closure.
ods-memo-oh-	-1.13	Real-time Leachate Detection System	and Measurement	S&M		EU	Need to Develop a Real-time, Monitoring and Sensing System to Determine the Integrity of Leachate Collection Systems and Detect Leaks In Collection System Lines.
ods-memo-oh-	-1.14	Passive Treatment of Leachate	e	S&M		EU	Need to Develop a Process For the Passive Treatment of Leachate.
ods-memo-oh-	-1.2	Leachate Collection and Trans Maintenance	smission Line	S&M		EU	Need to Develop Automated Technology to Unplug Leachate Collection and Transmission Lines.
ods-memo-oh-	-1.4	Perimeter Groundwater Well	Monitoring	S&M		W	Need to Develop Automated Technology to Monitor Perimeter Groundwater Wells to Determine Elevation of Water, Detect Contaminants, Etc.
ods-memo-oh-	-1.5	Monitoring Biological/chemic and Streams (Paddy's Run)	eal Properties of Ponds	S&M		S,W	Need to Develop Automated Method For Monitoring Biological and Chemical Properties of Ponds and Streams (Paddy's Run)
	CC = Caps a SS = Subsuri		PB = Physical Barriers Eco = Ecosystem Mon Tox = Toxicity				

Need Code	e Need Title		Catego	ry Contaminated Site Type	d Plain Language
ods-memo-oh-1	.6 Automated Meteorological M	onitoring Stations	S&M	AIR	Need to Construct Real Time Automated Meteorological Monitoring Stations.
ods-memo-oh-1	.7 Disposal Facility Physical Ch	ange Monitoring System	S&M,PB	EU,F	Need to Develop Technology to Measure Physical Changes and Differential Subsidence In Disposal Facilities.
ods-memo-oh-1	.8 Detection of Penetrations In I	Disposal Facilities	S&M,PB	EU,F	Need to Develop Automated Method to Detect Penetrations Or Intrusions of Water/moisture Or Groundwater Into Disposal Facilities.
ods-memo-oh-1	.9 Detection of Erosion and Run	off	S&M	S,W	Need to Develop Automated Technology to Detect, Measure and Monitor Erosion and Runoff From Remediated Areas and Disposal Facilities.
ods-rep-3.1	Better Tools For In-situ Field	Measurement	S&M,SS	S,W	Identifies the Need For Better Tools (e.g., In-situ Field Measurement) to Characterize and Accurately Predict (model) Contamination Movement Below Ground.
ods-rep-3.5	Methods For Designing Moni Current Conditions and Chang		S&M	S,W,EU,F	Need to Develop Methods For Designing Monitoring Systems to Detect Both Current Conditions and Changes In System.
ods-rep-4.7	Ambient Monitoring, Perform Detection Monitoring	nance Monitoring and	S&M	S,W,EU,F	A Complete Long Term Monitoring System Includes the Need For Ambient, Performance, and Detection Monitoring.
C	&M = Surveillance and Monitoring C = Caps and Covers S = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity	toring	W = Water S = Soil F = Facilities EU = Engineered Units	

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Need Code	Need Title		Catego	ry Contaminate Site Type	ed Plain Language
ods-rep-8-nm-1.	Cost Effective Monitoring ar Techniques	nd Surveillance	S&M	S,W,EU,F	Need For Improved, Cost Effective, Monitoring and Surveillance Techniques.
ods-rep-8-tn-1.3	Remote Monitoring Technique	ues	S&M,CC	EU	The Need For Remote Monitoring of Caps, Covers and Trenches to Detect Failures, Possibly Using Satellite Technology.
ods-rep-8-tn-1.5	Insitu Biological Monitoring Monitoring	to Replace Analytical	S&M	EU	Need For Insitu Biological Monitoring to Supplement and Eventually Replace Traditional Analytical Monitoring.
ods-rep-emsp-1.	Contaminant Monitors and E	viagnostic Parameters	S&M	S,W,EU,F	Need to Develop Improved Sensors and Define Diagnostic Parameters to Identify and Characterize the Presence of Contaminants In All Media.
ods-rep-emsp-1.2	Sensors to Monitor Physical Structures and Landfills	Integrity of Barriers,	S&M,PB	EU,F	Need to Develop Improved Sensors to Monitor Physical Integrity of Barriers, Structures and Landfills Post-closure.
ods-rep-emsp-1.3	Remote Sensing of Ecosystem	ms	S&M,ECO	S,W	Need to Develop Improved Remote Sensing of Ecosystem Indicators Including Vegetation.
OH-F048	Long-term Monitoring of Ca	ps and Covers	S&M,CC	EU	Need to Identify Improved Long-term Monitoring of the On-Site Disposal Facility Cover System.
C	M = Surveillance and Monitoring C = Caps and Covers S = Subsurface Science	PB = Physical Barriers Eco = Ecosystem Mor Tox = Toxicity		W = Water S = Soil F = Facilities	

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EU = Engineered Units

Need Co	ode Nee	d Title		Catego	•	ontaminated ite Type	l Plain Language
OH-F052	Long	-term Treatment and Mon	itoring of Leachate	S&M		EU	Need For a Stand-alone System to Detect and Treat Leachate After All Other Operating Systems Are Shut Down.
ORHY-21	Real	Time Performance Assess	ment Monitoring	S&M		S,W	Technologies For Real-time, In Situ Monitoring of Groundwater and Surface Water.
ORHY-21a	Real	Time Performance Assess	ment Monitoring	S&M		S,W	Technologies For Real-time, In Situ Monitoring of Groundwater and Surface Water (Paducah).
RL-DD052		-term Monitoring Around ity For CDI	and Under the 221-U	S&M		S,W	Technologies Are Needed to Monitor Contaminants In the Soil Around and Under the 221-U Facility to Verify That Contaminants Are Being Contained Now and In the Future.
RL-SS37-S	Monit Princi	toring of Contaminants - (iples	Chemical Sensor	SS,S&M		S,W	A Better Understanding of the Physics and Chemistry That Will Lead to More Accurate and More Sensitive Measurements of Contaminant Concentrations.
RL-SS38	Trans	rstand, Quantify and Deve sport and Transformation ndwater-derived Contami	of	SS,S&M		S,W	Develop a System (techniques/equipment/instrumentation) to Measure Chemical, Physical, and Biological Parameters In the Area Between the Aquifer and the River, and to Validate and Verify Models.
Legend:	S&M = Surveillance CC = Caps and Co SS = Subsurface Sc	vers	PB = Physical Barriers Eco = Ecosystem Moni Tox = Toxicity	toring	W = Wat S = Soil F = Facil EU = En		

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Need Code	Need Title	Category	Contaminated Site Type	Plain Language
SR00-3027	Long Term Monitoring Technologies	S&M		Need to Develop Insitu Remote Monitoring Technologies to Reduce the Cost of Data Collection Associated With Waste Sites.

S&M = Surveillance and Monitoring

CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water S = Soil

F = Facilities

EU = Engineered Units

03-Aug-00 Appendix A, Attachment D

# **Attachment E -- Caps and Covers Needs**

# **Caps and Covers**

Need Code	NEED TITLE		Catego	ry Contami Site Typ	5 5
AL-00-01-04-SC	Long-term Monitoring Stra Techniques to Evaluate the Disposal Area Engineered	Design of Material	S&M,CC	EU	Improved Methods of Monitoring the Performance Or Stability of Engineered Caps Or Covers; Cost Savings Is a Goal.
AL-09-01-03-SC-S	Succession and Long-term Landfill Covers	Performance of	CC	EU	Effects On the Performance of Landfill Covers Caused By Plant Succession.
nv11-0001-08	Long Term Management of Containers, and Cover Sub- Waste		CC	EU	Methods Need to Be Developed to Better Predict the Dynamics of Collapse of Void Space, Container/waste Form Degradation, and Subsidence of Cap Materials.
nv12-0001-06	Long Term, Flexible Arid S	Site Closure Cover	CC	EU	Development of a Long-lasting, Cost-effective Closure Caps For Desert Conditions Like Those At NTS Is Needed.
ods-int-gjpo-1.5	Ways to Measure Moisture	Flows In Caps	S&M,CC	EU	Need to Develop a More Cost Effective, Remotely Operated Device to Measure Moisture In/under Caps and Covers.
ods-int-id-6.4	Improved Closure Cap Cov Monitoring System	er Design and	CC	EU	Need to Design a Closure Cap/cover and Monitoring System to Maintain Integrity Over the Long Term.
ods-int-id-7.2	Need to Determine Cap Du	rability	CC	EU	Need to Improve Cap Durability and a Better Understanding of Contaminant Retention Rates, Dispersivity, Plant Uptake Factors, Bio-accumulation Rates, Fracture Flow Rates, and Boundary Conditions.
Legend: S&M = Surv CC = Caps SS = Subsur		PB = Physical Barri Eco = Ecosystem M Tox = Toxicity		W = Water S = Soil F = Facilities EU = Engineered Units	s

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### **Caps and Covers**

Need Code	NEED TITLE	Category	Contaminated Site Type	d Plain Language
ods-int-id-8.2	Ways to Quantify Moisture In/under Caps	S&M,CC	EU,S	Need to Develop Capability to Quantify Moisture In and Under Covers/caps.
ods-memo-id-1.4	Engineering Solutions For Permanent Control of Residual Contamination and Waste Left In Place	PB,CC	EU,F	Need For a Better Understanding of Long-term Performance of Engineered Solutions.
ods-rep-8-tn-1.3	Remote Monitoring Techniques	S&M,CC	EU	The Need For Remote Monitoring of Caps, Covers and Trenches to Detect Failures, Possibly Using Satellite Technology.
ОН-F048	Long-term Monitoring of Caps and Covers	S&M,CC	EU	Need to Identify Improved Long-term Monitoring of the On-Site Disposal Facility Cover System.
RL-WT017	Long-term Testing of Surface Barrier	PB,CC	EU,F	There Is a Need For Better Understanding of Long-term Performance of Surface Barriers to Reduce Moisture Infiltration and Plant and Animal Intrusion.

Legend: S&M = Surveillance and

CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water S = Soil

F = Facilities

EU = Engineered Units

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Appendix A, Attachment E

### **Attachment F -- Information Management Needs**

#### **Information Management**

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
AL-09-02-02-SC	Environmental Restoration (ER) Site Hazard Information System	IM	S,W,EU,F	Need to Develop An Information System to Ensure the Availability and Retreivability of Site Hazard Information In Real-time For Future Site Activities (including Emergency Response)
ods-int-id-4.1	Long-term Information and Records Management System	IM	S,W,EU,F	Need For Long-term Records Management System.
ods-int-id-7.4	Groundwater Monitoring Using Electronic Data Transmission	IM	S,W,EU,F	Need to Capture Groundwater Data, Unexploded Ordnance Locations, and General Records, and Official Records (including Log Books) In Perpetuity. Need For Comprehensive Site-wide Data Storage System.
ods-memo-id-1.6	Tools For the Management For Information of Future Generations	IM	S,W,EU,F	Need to Develop Tools to Ensure Information Management and Transfer to Future Generations.
ods-memo-oh-1.1	Long Term Record Keeping and Retrievability	IM	S,W,EU,F	Need to Develop a Record Keeping System That Is Easily Accessed and Maintained.
ods-rep-2	LTS Data and Information Management Needs From the Working Draft	IM	S,W,EU,F	There Is a Need For LTS Data Standards For Storage and Use.

S&M = Surveillance and Monitoring

CC = Caps and Covers SS = Subsurface Science

PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water

S = Soil F = Facilities

EU = Engineered Units

03-Aug-00 Appendix A, Attachment F

#### **Information Management**

Need Code	Need Title	Category	Contaminated Site Type	l Plain Language
RL-SS40	Provide a Method to Develop Mass Balance (i.e., Holistic) Inventory Estimates	IM	S,W,EU,F	There Is a Need For a Single and Consistent Inventory of the Discharges and Disposals of Radionuclides and Chemicals to the Surface and Subsurface.
RL-WT043-S	Effect of Human and Natural Influences On Long-term Water Distribution	IM	S,W,EU,F	A Need to Better Understand Long Term Land and Water Use At DOE Sites Considering Climate Change and the Ability to Incorporate Impacts of Those Changes Into Models to Predict the Movement of Contaminants.
SR00-4010	Characterization Data Management	IM	S,W,EU,F	Need to Develop a Relational Database to Allow Storage and Retrieval of Comprehensive Data, Including Photos and Videos Related a D&D Project.

Legend: S&M = Surveillance and Monitoring CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water S = Soil F = Facilities

EU = Engineered Units

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# **Attachment G -- Physical Barriers Needs**

# **Physical Barriers**

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
ID-1.1.05	Detect Interactions Between Spent Nuclear Fuel and Storage Containers	S&M,PB	EU	Technology Needed to Detect Corrosion of SNF and Storage Containers.
ID-S.1.12	Understanding the Behavior of Waste Forms and Their Near-field Transport	РВ	EU	Need to Improve Conceptual Models to More Accurately Estimate Releases From Contaminant Waste Forms.
ods-int-gjpo-1.2	Long-life Signage	S&M,PB	EU	Need For Improved, More Durable Signs That Are More Resistant to Weather and Vandalism.
ods-int-gjpo-1.3	Ways to Strengthen Physical Or Institutional Controls	PB	EU	Need For Improved Physical Barriers and Intrusion Prevention Systems.
ods-memo-id-1.4	Engineering Solutions For Permanent Control of Residual Contamination and Waste Left In Place	РВ,СС	EU,F	Need For a Better Understanding of Long-term Performance of Engineered Solutions.
ods-memo-oh-1.7	Disposal Facility Physical Change Monitoring System	S&M,PB	EU,F	Need to Develop Technology to Measure Physical Changes and Differential Subsidence In Disposal Facilities.
ods-memo-oh-1.8	Detection of Penetrations In Disposal Facilities	S&M,PB	EU,F	Need to Develop Automated Method to Detect Penetrations Or Intrusions of Water/moisture Or Groundwater Into Disposal Facilities.

Legend: S&M = Surveillance and Monitoring

CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers

Eco = Ecosysem Monitoring
Tox = Toxicity

W = Water S = Soil

F = Facilities

EU = Engineered Units

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# **Physical Barriers**

Need Code	Need Title	Category	Contaminated Site Type	d Plain Language
ods-rep-3.4	Methods to Validate Containment and Stabilization	РВ	EU,F	A Need For Methods to Validate Containment and Stabilization Systems to Ensure Long-term Protection.
ods-rep-4.3	Better Analysis and Assessment Stages For Repository Sites	РВ	EU	Need For An Improved Repository Design That Creates No Undue Future Risks.
ods-rep-8-tn-1.1	Enhanced Reliability of Engineered Controls	РВ	EU,F	Need For Improved Ability to Predict and Assess Long-term Performance of Engineered Controls (Isolation Caps and Trenches, Reactive Barriers, Etc) and Monitoring Systems.
ods-rep-emsp-1.2	Sensors to Monitor Physical Integrity of Barriers, Structures and Landfills	S&M,PB	EU,F	Need to Develop Improved Sensors to Monitor Physical Integrity of Barriers, Structures and Landfills Post-closure.
RL-WT017	Long-term Testing of Surface Barrier	PB,CC	EU,F	There Is a Need For Better Understanding of Long-term Performance of Surface Barriers to Reduce Moisture Infiltration and Plant and Animal Intrusion.
SR00-1030	Model Degradation In Cement Based Wasteform (e.g., Saltstone) and Concrete Vault Degradation and Collapse	РВ	EU,F	There Is a Need to Develop a Model to Simulate the Degradation of Saltstone, a Cement-based Wasteform, and the Concrete Vaults Into Which It Is Emplaced Over Time Periods of Thousands of Years.

Legend: S&M = Surveillance and Monitoring CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers Eco = Ecosysem Monitoring Tox = Toxicity W = Water S = Soil F = Facilities

EU = Engineered Units

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### **Attachment H -- Ecosystem Monitoring Needs**

# **Ecosystem Monitoring**

			Contaminate	d
Need Code	Need Title	Category	Site Type	Plain Language
AL-09-01-16-Risk-S	Extrapolation Bias and Uncertainty From Using Biomarkers and Numerical Models to Predict Real Ecological Effects	ECO	S,W	A Better Understanding of the Relationship Between Field Data and Model Assumptions to Quantify the Uncertainty of Model Predictions of Ecological Risk.
ods-rep-emsp-1.3	Remote Sensing of Ecosystems	S&M,ECO	S,W	Need to Develop Improved Remote Sensing of Ecosystem Indicators Including Vegetation.

Legend: S&M = Surveillance and Monitoring

CC = Caps and Covers SS = Subsurface Science PB = Physical Barriers Eco = Ecosystem Monitoring W = Water S = Soil F = Facilities

Tox = Toxicity

EU = Engineered Units

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### **Attachment I -- Toxicity Needs**

### **Toxicity**

Need Code	Need Title	Category	Contaminated Site Type	Plain Language
ID-S.1.16	Quantifying Uncertainty In Risk Calculations	TOX		A Better Understanding of the Health Effects of Mixtures of Contaminants and Quantifying the Uncertainties of Health Effects Will Improve Risk Calculations.
RL-SS39	Understand and Provide Means to Quantify the Impacts of River Contamination On Receptors	TOX		Need to Develop Consistent Ways to Measure Impacts (Human, Ecological, Cultural, Socioeconomic) to Exposed Groups. Information Will Be Used to Determine Toxicity Benchmarks For the Decision-making Process.

egend: S&M = Surveillance and Monitoring

CC = Caps and Covers

SS = Subsurface Science

PB = Physical Barriers Eco = Ecosystem Monitoring

Tox = Toxicity

W = Water

S = Soil

F = Facilities

EU = Engineered Units

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### **Attachment J -- Non Science and Technology Needs**

#### Non S and T

Need Co	de	Need Title		Category	Contaminated Site Type	l Plain Language
AL-09-01-33-N	NM	Core Scientific R&D Capabilit Material Management Needs	y In Support of Nuclear			Need For Retention of Scientific Expertise (Chemistry and Physics) Related to Safety and Health Issues For Stabilization and Storage of Nuclear Materials.
ods-int-id-1.4		Policy For Determining Level Control	of Security For Access			A Policy Is Needed to Determine the Level of Security (Access Control) Required For An Entombed Facility/structure.
ods-int-id-1.5		Uniform DOE Policy For Stak	eholder Issues			Need For a National Policy That Addresses Stakeholder Concerns About Entombment/D&D Practices That Apply to All Sites Uniformly.
ods-int-id-5.2		Method to Monitor Impacts of Requirements and Toxicity Da				Need Method to Monitor the Impacts of Changes On Modeling Requirements and Toxicity Data.
ods-memo-id-	-1.3	Methods to Support the Integra Management With LTS	ation of Land			Need to Evaluate the Impact of End-State Decisions On Future Land-use Options.
ods-memo-id-	1.5	Strong Cost Estimating Tools	For LTS			A Need For Better Tools For Defensible Life-cycle Cost Estimates For LTS.
ods-memo-oh	-1.3	Automated Security System				Need to Develop An Automated Security System.
Legend:	S&M = Surve CC = Caps : SS = Subsur		PB = Physical Barriers Eco = Ecosystem Monit Tox = Toxicity	oring S = S	Water Soil Facilities	

EU = Engineered Units

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#### Non S and T

Need Co	de Need Title	Categor	y Contaminated Site Type	Plain Language
ods-rep-3.2	Improved Interagency Coordi	ination		Need For Improved Interagency Coordination Among 18 Specific Research Programs On Hazardous Chemicals and Heavy Metals Directly Related to EM Science Program and DOE Cleanup.
ods-rep-3.3	Long-term Emphasis of Research	arch Focus		EM Science Program Should Emphasize Four Research Areas: (1) Characterization of Subsurface Contaminants and The Subsurface, (2) Conceptual Modeling, (3) Containment and Stabilization, (4) Monitoring and Validation.
ods-rep-3.6	Research Dealing With Trans Involving Metals and Radion			Need Specific Research Dealing With Transuranic Contaminants Involving Metals and Radionuclides.
ods-rep-3.7	Integration of Research Community of Researchers	munity to Broaden		Need to Integrate Research From Government Agencies With Research Capabilities, National Laboratories, Universities, and Industry.
ods-rep-4.1	Develop Integrated Solution and Future Technologies	With Regards to Present		Need to Identify Present and Future Subsurface Technologies, Technology Gaps, and Combining Them For An "Integrated Solution."
RF-SNM18	Core Scientific R&D Capabil Nuclear Material Managemen			Need For Retention of Scientific Expertise (Chemistry and Physics) Related to Safety and Health Issues For Stabilization and Storage of Nuclear Materials.
Legend:	S&M = Surveillance and Monitoring CC = Caps and Covers SS = Subsurface Science	Eco = Ecosystem Monitoring	V = Water S = Soil F = Facilities	
03-Aug-0	00	E	EU = Engineered Units	Appendix A, Attachment J
				Appendix A, Attaonment o

# Attachment K – Complete Set of Screened LTS Needs

PLAIN LANGUAGE:	Improved Methods Of Monitoring The Performance Or Stability Of Engineered Caps Or Covers; Cos Savings Is A Goal.
NEED TITLE:	Long-term Monitoring Strategies And Techniques To Evaluate The Design Of Material Disposal Area Engineered Covers
NEED CODE:	AL-00-01-04-SC

						<u>SC</u>	REEN	<u>ING CATE</u>	<u>EGORIES</u>								
SCREENING QUESTIONS																	
Pertains to site maintenance		Waste Form/Physical Barriers		Data Co Transm	ollection/ ission			Informatio Manageme			Envi Setti	ronme ng	ntal			Cross Cutting	3
Relates to final engineered system performance													Ition				_
Improves data management								*	s Mgmt its	eling	ors	Sis	nce Validation		ring		
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq, Inspection Cost Water Soil	Facility Sensor/Device	Durability Maintainability Calibration	Inspection Freq. Inspection Cost Water Soil	Engineered Units Facility	Data Analysis Data Interpretation	bility bility on s Mgmt	Record	Contaminant Modeling Fate & Transport	ity ogical li	Jncertainty Analysis Subsurface Issues Model Validation	System Performance Water	Engineered Units Facility	Long Term Monitoring	Ę	Engineered Units Facility
Involves long term monitoring and surveillance	х	Durabil Mainta Monito Predict Inspec Inspec Water Soil Engine	Facili	Durability Maintaina Calibratio	Inspec Inspec Water Soil	Engine Facility	Data Data	Reportin Accessib Retention Records	Water Soil Engine Facility	Conta	Toxicity	Subs	Systen Water	Engir Facili	Long	Kisk Water Soil	Engir
Pertains to non S and T															П		
Better confidence in risk prediction																	
Enhances ability to respond to failure in final configuration																	

NEED CODE:	AL-09-01-01-SC-S
NEED TITLE:	Transport Of HE And Metals In Fractured Rock And Surface Alluvial Systems
PLAIN LANGUAGE:	Improved Understanding Of The Movement Of High Explosives (RDX) Components And Metal Contaminants (particularly Barium) Below Ground.

	SCREENING CATEGORIES													
SCREENING QUESTIONS														
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting								
Relates to final engineered system performance					tion									
Improves data management				gmt	aling orrs sis ce Validation	ring								
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Soil Facility Data Analysis	Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility								
Involves long term monitoring and surveillance		Durability Maintaina Monitoring Predictabi Inspectior Inspectior Nater Soil Engineere	Sensor, Durabili Maintail Calibrat Inspect Inspect Water Soil Enginee Facility	Data Inter Reporting Accessibil Retention Records N Cost of Re Water Soil Engineere	Contam Fate & 1 Toxicity Ecologii Uncerta Subsurf Model v System Water Soil Enginee	Long T Risk Water Soil Engine								
Pertains to non S and T														
Better confidence in risk prediction	x													
Enhances ability to respond to failure in final configuration														

NEED CODE:	AL-09-01-03-SC-S
NEED TITLE:	Succession And Long-term Performance Of Landfill Covers
PLAIN LANGUAGE:	Effects On The Performance Of Landfill Covers Caused By Plant Succession.

	SCREENING CATEGORIES																													
SCREENING QUESTIONS																														
Pertains to site maintenance		Waste Form/Physical Barriers		- 1		Colle	ction ion	/						ation emer	- 1						riroi ting		ental					Cro:		
Relates to final engineered system performance	х																		_				tion	_			_			•
Improves data management											_			lgmt				eling		ors	sis	_	ice Validation				ring			
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility		sensor/Device Durability	Maintainability	Calibration Inspection Freq.	Inspection Cost Water		Facility	Data Analysis	Data Interpretation	Reporting Accessibility	ntion	Records Mgmt Cost of Records Mgmt	_	Soli Engineered Units	ty	Contaminant Modeling	Fate & Transport	Foological Indicators	Jncertainty Analysis	Subsurface Issues	viodel validation System Performance	_	Engineered Units	ty	Term Monitoring	_	1	Engineered Units Facility
Involves long term monitoring and surveillance	х	Durability Maintaine Monitorin Predictab Inspection Inspection Water Soil Engineer		Sensor/Dr Durability	Maint	Inspe	Inspec	Soil	Facility	Data	Data	Reporting Accessibil	Retention	Cost	Water	Engir	Facility	Cont	Fate & Tovicity	Ecolo	Unce	SqnS	Syste	Water	Engir	Facili	Long	Kisk	Soil	Facili
Pertains to non S and T																											П			
Better confidence in risk prediction	х																													
Enhances ability to respond to failure in final configuration																														

NEED CODE:	AL-09-01-06-SC-S
NEED TITLE:	Issue Of Scale In Flow Prediction And Contaminant Remediation In Porous Media
PLAIN LANGUAGE:	Improved Ability To Predict Flow And Transport Below Ground That Captures The Large And Small Scale Physical Processes That Affect Water Movement.

	SCREENING CATEGORIES																										
SCREENING QUESTIONS																											
Pertains to site maintenance		Waste For Barriers	m/Physi	cal			a Colle		1/					ation	t				Envir Setti		enta	al				oss	
Relates to final engineered system performance															_			_				 Logi					-
Improves data management												_		lgmt			guile		ors :-	2		ce Validation		200	ב ב		
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability	Inspection Freq. Inspection Cost Water	Soil Engineered Units Facility	Sensor/Device	Durability Maintainability	Calibration Inspection Freq.	tion		Engineered Units Facility	Data Analysis Data Interpretation	rting	Accessibility Retention	Records Mgmt Cost of Records Mgmt	_	Engineered Units Facility	Contaminant Modeling	Fate & Transport Toxicity	<u>=</u> :	Subsurface Issues	Model Validation	System Pertormance Nater	Engineered Units Facility	Term Monitoring	5	_	Engineered Units Facility
Involves long term monitoring and surveillance		Durability Maintaina Monitorin Predictab	Inspec Inspec Water	Soil Engined Facility	Sens	Durability Maintaina	Calib	Inspec	Soil	Facility	Data	Reporting	Accessibil	Reco	Water	Engine Facility	Cont	Fate & Toxicity	Ecolo	sqnS	Mode	Systen	Engir		Risk	Water	Engir
Pertains to non S and T												П					Х	Х		Х	Х	Х		] [			
Better confidence in risk prediction	х																										
Enhances ability to respond to failure in final configuration																											

NEED CODE:	AL-09-01-07-SC-S
NEED TITLE:	Integration Of Reactive Chemistry Into Field-scale Transport Models
PLAIN LANGUAGE:	Improved Predictive Modeling Capabilities That Address Complex Chemical And Flow Processes.

	SCREENING CATEGORIES													
SCREENING QUESTIONS														
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting								
Relates to final engineered system performance					tion									
Improves data management				dgmt	eling ors sis s	oring								
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \( \) Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility								
Involves long term monitoring and surveillance		Durability Maintaina Maintaina Monitoring Predictabi Inspection Inspection Water Soil Engineere Facility	Sensor/De Durability Maintainach Calibration Inspection Inspection Water Soil Engineere Facility	Data Analy Data Interpressibility Reporting Accessibility Retention Records IV Cost of Re Water Soil Engineere	Contam Fate & 1 Toxicity Ecologi Uncerta Subsurf Model V System Water Soil Enginee	Long 7 Risk Water Soil Engine								
Pertains to non S and T														
Better confidence in risk prediction	x													
Enhances ability to respond to failure in final configuration														

NEED TITLE:	Differences Between Saturated And Unsaturated Systems			
PLAIN LANGUAGE:	Contaminants Travel Differently In Wet And Dry Below Ground Environments. Understand The Differences.	There Is A Need To Better		

AL-09-01-08-SC-S

NEED CODE:

			SCREENING CATEGO	ORIES
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management	Environmental Cross Setting Cutting
Relates to final engineered system performance				gg,
Improves data management			d d	aling irs is ce Validation
Contributes to better understanding of fate and transport	x	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water	Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance v Water Soil Engineered Units Facility Long Term Monitoring Risk Water Soil Engineered Units Facility Facility Facility
Involves long term monitoring and surveillance		Durability Maintaina Monitoring Predictabl Inspectior Inspectior Vater Soil Engineere Facility	Durability Maintainal Calibration Inspection Inspection Water Soil Engineere Facility Data Anal Data Inter Reporting Recention Recessibil	Soil Enginee Facility Contam Fate & 1 Toxicity Ecologic Uncare Subsurfa Subsurfa Subsurfa Subsurfa Subsurfa Soil Enginee Facility Long Te Risk Water Soil Enginee Facility
Pertains to non S and T				
Better confidence in risk prediction	х			
Enhances ability to respond to failure in final configuration				

NEED TITLE:	Physics Of Fracture Flow And Transport In The Vadose Zone
PLAIN LANGUAGE:	Better Understanding Of The Importance Of Cracks In Below Ground Water Movement Will Improve Models.

AL-09-01-10-SC-S

NEED CODE:

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Environmental Setting	Cross Cutting
Relates to final engineered system performance			tion of the contract of the co	
Improves data management			gmt sling iss	rin B
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Alater Soil Engineered Units Facility	Durability Maintainability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Data Analysis Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water	Eacility Long Term Monitoring Risk Water Soil Engineered Units Facility
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Enhances ability to respond to failure in final configuration				

NEED CODE:	AL-09-01-11-SC-S
NEED TITLE:	Water Fluxes And Solute Transport In Arid And Semiarid Environments
PLAIN LANGUAGE:	Better Understanding Of Water Movement Over Time And Area In Arid And Semi-arid Underground Environments, And Water Vapor Exchange At The Ground Surface.

SCREENING QUESTIONS	1		<u>sc</u>	CREENING CATEGORIES		
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Contributes to better understanding of fate and transport	x	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \( \) Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility
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NEED CODE:	AL-09-01-12-5C-5
NEED TITLE:	Groundwater-surface Water Interactions
PLAIN LANGUAGE:	Better Understanding Of The Interaction Between Groundwater And Surface Water, I.e., What Affect Does Groundwater Pumping Have On Streamflow, And What Affect Does Surface Water Diversion Have On Groundwater Recharge.

SCREENING QUESTIONS	l I		SCREENING CATEGORIES	
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Enhances ability to respond to failure in final configuration				

NEED CODE:	AL-09-01-15-SC-S
NEED TITLE:	Separation Of Metals And Radionuclides From Uncontaminated Soils; Transport Of Metals And Radionuclides In Sediments And Surface Alluvial Systems
PLAIN LANGUAGE:	Better Understanding Of The Separation And Movement Of Metals And Radionuclides From Soils And Sediment.

SCREENING QUESTIONS	 		SCREENING CATEGORIES		
Pertains to site maintenance	$ \Box $	Waste Form/Physical Barriers	Data Collection/ Transmission Information Management	Environmental Setting	Cross Cutting
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Better confidence in risk prediction	x				
Enhances ability to respond to failure in final configuration					

NEED CODE:	AL-09-01-16-RISK-S
NEED TITLE:	Extrapolation Bias And Uncertainty From Using Biomarkers And Numerical Models To Predict Real Ecological Effects
PLAIN LANGUAGE:	A Better Understanding Of The Relationship Between Field Data And Model Assumptions To Quantify The Uncertainty Of Model Predictions Of Ecological Risk.

		SCREENING CATEGORIES				
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Better confidence in risk prediction	x					
Enhances ability to respond to failure in final configuration						

NEED TITLE:	Core Scientific R&d Capability In Support Of Nuclear Material Management Needs
PLAIN LANGUAGE:	Need For Retention Of Scientific Expertise (chemistry And Physics) Related To Safety And Health Issues For Stabilization And Storage Of Nuclear Materials.

AL-09-01-33-NM

NEED CODE:

	SCREENING CATEGORIES												
SCREENING QUESTIONS													
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Better confidence in risk prediction	$ \Box $												
Enhances ability to respond to failure in final configuration													

NEED CODE:	AL-09	9-02-01-SC													
NEED TITLE:	Long-	Long-term Site Monitoring System													
PLAIN LANGUAGE:	Impro	oved Site Monitoring And Surve	illance System Resulti	ing In C	ost Reductions.										
SCREENING QUESTIONS				<u>SCI</u>	REENING CATEGORIES										
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission		Information Management	Environmental Setting	Cross Cutting								
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Frediity	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil	Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units								
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Better confidence in risk prediction															
Enhances ability to respond to															

failure in final configuration

NEED CODE:	AL-09-02-02-SC
NEED TITLE:	Environmental Restoration (er) Site Hazard Information System
PLAIN LANGUAGE:	Need To Develop An Information System To Ensure The Availability And Retreivability Of Site Hazard Information In Real-time For Future Site Activities (including Emergency Response)

	SCREENING CATEGORIES												
SCREENING QUESTIONS				1									
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Relates to final engineered system performance			tion										
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensofizerion Sensofizerion Durability Maintainability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Records Mgmt Cost of Records Mgmt Mater Soil Contaminant Modeling Facility Uncertainty Analysis Subsurface Issues Model Validation System Performance v Water Soil Engineered Units Facility Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility									
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Better confidence in risk prediction													
Enhances ability to respond to failure in final configuration	х												

NEED CODE:	CH-5504-99
NEED TITLE:	Long-term Groundwater Monitoring
PLAIN LANGUAGE:	Need For Enhanced Or New Monitoring Techniques That Allow More Reliable, Quick And Inexpensive Groundwater Analysis.

	SCREENING CATEGORIES																						
SCREENING QUESTIONS																							
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Relates to final engineered system performance			_											_			<u>.</u>	_					_
Improves data management	x										Mgmt		puile	n	<u>ر</u>	S	ce Validation			1	5		
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Better confidence in risk prediction	x																						
Enhances ability to respond to failure in final configuration																							

NEED TITLE:	Detect Interactions Between Spent Nuclear Fuel And Storage Containers
PLAIN LANGUAGE:	Technology Needed To Detect Corrosion Of SNF And Storage Containers.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				1
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting
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surveillance			(	
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	id-6.1.02  Real-time Field Instrumentation For Characterization And Monitoring Soils And Groundwater.
NEED THEE.	The artiful and the artiful attention of the action of the artiful attention of the artiful atte
PLAIN LANGUAGE:	Rapid And Accurate Instrumentation Needed To Identify Groundwater And Soil Contamination Concentrations To Compare With Risk-based Levels.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
Relates to final engineered system performance			tion	
Improves data management			Mgmt Mgmt ttors yeis as ance Validation	gui
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Fecility	evice  ability  n Freq.  n Cost  lysis  lysis  Mgmt  ed Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction	х			
Enhances ability to respond to failure in final configuration				

NEED CODE:	id-6.1.27
NEED TITLE:	Integrated Suite Of In Situ Instruments To Determine Flux In The Vadose Zone.
PLAIN LANGUAGE:	Integrated Tools And Devices Are Needed To Directly Measure Contaminant Flux As Key Modeling Input To Improve Predictions.

SCREENING QUESTIONS	l I		SCREENING CATEGORIES	
Pertains to site maintenance	$ \Box $	Waste Form/Physical Barriers	Data Collection/ Transmission Information Management Environmental Setting	Cross Cutting
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Improves data management	$ \Box $		Mgmt Mgmt ttors ysis	<u></u>
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	wice of the cost o	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	10-6.1.30
NEED TITLE:	Instrumentation To Reliably Measure Soil Gas Flux Accounting For Barometric And Temporal Variations.
PLAIN LANGUAGE:	The Ability To Quantify The Affects Of Natural Changes In Temperature And Barometric Pressure On The Movements Of Organics In Soil.

			SCREENING CATEGORIES																						
SCREENING QUESTIONS																									
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Enhances ability to respond to failure in final configuration																									

NEED CODE:	ID-6.1.34
NEED TITLE:	Improved Passive Vapor Extraction Technology.
PLAIN LANGUAGE:	Better Understanding Of Natural Changes In Temperature And Pressure That Affect Soil Gas Movement To
	Depths Of 600 Feet Vs. The Current Capability Of 20 Feet.

			SCREENING CATED	<u>GORIES</u>
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Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	oillity Cost Cost d Unitt	erred Unitity  Transport  Y  Y  Ininant Mo  Y  Y  Y  Y  Y  Y  Y  Y  Y  Y  Y  Y  Y
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Enhances ability to respond to failure in final configuration				

NEED CODE:	id-S.1.01
NEED TITLE:	Microbial Alteration Of Heavy Metal And Radionuclide Partitioning At Mineral Surfaces
PLAIN LANGUAGE:	Need To Study Biological Processes That Affect Mobility And Partitioning Of Heavy Metals And Rad Contaminants.

			SCREENING CATEGORIES																							
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Better confidence in risk prediction	x																									
Enhances ability to respond to failure in final configuration																										

NEED CODE:	id-S.1.04
NEED TITLE:	Real-time Field Instrumentation For Characterization And Monitoring Soils And Groundwater.
PLAIN LANGUAGE:	Need Is For Faster And Cheaper Detection Devices To Aid In Soil And Groundwater Characterization Sampling And Monitoring Of Contaminants Below Ground.

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Enhances ability to respond to failure in final configuration																									

NEED CODE:	id-S.1.09
NEED TITLE:	Characterization Of Scale And Spatial Heterogeneity And Preferential Flow
PLAIN LANGUAGE:	Need To Improve The Ability To Predict Flow And Transport Modeling Of Contamination Below Ground. Thi Deals With The Uneven Distribution Of Contaminant Pathways And Our Ability To Predict Preferential Flow.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management	Environmental Cross Cutting
Relates to final engineered system performance				ation
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	and Monite	Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Water Soil Engineered Units Facility Long Term Monitoring Risk Water Soil Engineered Units Facility
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Enhances ability to respond to failure in final configuration				

NEED CODE:	ID-S.1.10
NEED TITLE:	Geochemistry Of Contaminants In The Vadose Zone
PLAIN LANGUAGE:	Need For Better Understanding Of Interaction Between Geology And Contaminants Below Ground. Will Improve Movement Predictions.

SCREENING QUESTIONS	 		SCREENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance				tion	
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Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	wice onling and the control of the c	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Wodel Validation System Performance \( Validatio \) Water Soil Engineered Units Facility	Long term wontoring Risk Water Soil Engineered Units Facility
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Enhances ability to respond to failure in final configuration					

PLAIN LANGUAGE:	Improve Modeling For Contaminant Movement Below Ground.
NEED TITLE:	Modeling Of Flow And Transport In The Vadose Zone
NEED CODE:	ID-S.1.11

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SCREENING QUESTIONS																									
Pertains to site maintenance		Waste Form/Physical Barriers		1 1	ata Co ransm					- 1		ation gemen	- 1			1	/iron ting	ment	al				Cros: Cutti		
Relates to final engineered system performance										_			_						lion						
Improves data management										_		lgmt			guile	Sic	sis		nce Validation			ring			
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil	acility	Sensor/Device Durability	9 -	Inspection Freq. Inspection Cost	<b>J</b> 6	Engineered Units Facility	Data Analysis	Data Interpretation Reporting	Accessibility Retention	Records Mgmt Cost of Records Mgmt	<b>5</b> 0	Engineered Units Facility	Contaminant Modeling Fate & Transport	Toxicity  Feological Indicators	Uncertainty Analysis	Model Validation	em Performance er	Soil Engineered Units	ity	Long Term Monitoring	<u>.</u>	Soil Engineered Units	<u>i</u> £
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Better confidence in risk prediction	x																								
Enhances ability to respond to failure in final configuration																									

NEED CODE:	ID-S.1.12
NEED TITLE:	Understanding The Behavior Of Waste Forms And Their Near-field Transport
PLAIN LANGUAGE:	Need To Improved Conceptual Models To More Accurately Estimate Releases From Contaminant Waste Forms.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management	Environmental Cross Cutting
Relates to final engineered system performance				ation
Improves data management			Mgmt Mgmt	is ce Validation ing
Contributes to better understanding of fate and transport	X	Durability Manitarinability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	vice oility  Freq. Cost Cost A Units Agmt cords ant Moannesport	
Involves long term monitoring and surveillance		Durability Maintaina Monitoriny Predictab Inspection Inspection Water Soil Engineere Facility	Sensor/De Durability Maintainal Calibration Inspection Water Soil Engineere Reporting Records N Cost of Re Water Soil Engineere Records N Cost of Re Water Soil Engineere Facility Records N Cost of Re Water Soil Engineere	Toxicity Ecologic Uncerta Subsurf Model V System Water Soil Enginee Facility Risk Water Soil Enginee Risk Water Soil Enginee Risk Water Soil Enginee
Pertains to non S and T		[		_
Better confidence in risk prediction	х			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ID-S.1.14
NEED TITLE:	Transport Of Contaminants In The Vapor Phase
PLAIN LANGUAGE:	Better Understanding And Characterization Of How Contaminants Move In The Soil Gas Phase Below Ground.

SCREENING QUESTIONS	l		so	CREENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					uoi	
Improves data management				gmt	ling rs is	gui
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance		Durability Maintainabili Monitoring Predictability Inspection Fr Inspection C Vater Soil Engineered I	Sensor/De Durability Maintainab Calibration Inspection Inspection Water Soil Engineerer Facility	Data Analys Data Interpre Reporting Reporting Accessibility Retention Records Mg Cost of Reco Water Soil Engineered Facility	Contaminan Fate & Tran Toxicity Ecological II Uncertainty Subsurface Model Valid System Per Water Soil Engineered Facility	Long Term Risk Water Soil Engineered
Pertains to non S and T						
Better confidence in risk prediction	x					
Enhances ability to respond to failure in final configuration						

NEED CODE:	ID-S.1.15
NEED TITLE:	Physics Of Flow In The Vadose Zone
PLAIN LANGUAGE:	Need To Conduct Research To Improve Our Ability To Quantify And Predict Contimanant Transport In Below Ground.

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SCREENING QUESTIONS																														
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Relates to final engineered system performance					_												_			_				lion						
Improves data management													_			lgmt			eling		ors.	SIS		nce Validation			ring			
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring	Predictability Inspection Freq. Inspection Cost	-	Engineered Units Facility	Sensor/Device	Durability Maintainability	Calibration	Inspection Freq. Inspection Cost	<b>5</b>	Engineered Units Facility	Analysis	Data Interpretation	Reporting Accessibility	Retention	<u> </u>	Water Soil	neered Units ity	Contaminant Modeling	& Transport	Ecological Indicators	Jncertainty Analysis Subsurface Issues	Model Validation	System Performance Water	Soil Engineered Units	ity	Term Monitoring	J.	7	Engineered Units Facility
Involves long term monitoring and surveillance		Dura Main Moni	Pred Inspe	Water	Engine Facility	Sens	Dura Main	Calib	luspe	Wate	Engine Facility	Data	Data	Repo	Retention	Cost	Water	Engine	Cont	Fate & Toxicity	Ecol :	Subs	Mod	Systen	Soil	Facility	Long	Risk Water	Soil	Facil
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Enhances ability to respond to failure in final configuration																														

NEED CODE:	ID-S.1.16
NEED TITLE:	Quantifying Uncertainty In Risk Calculations
PLAIN LANGUAGE:	A Better Understanding Of The Health Effects Of Mixtures Of Contaminants And Quantifying The Uncertainties Of Health Effects Will Improve Risk Calculations.

		ı	SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
Relates to final engineered system performance			uoi	
Improves data management			gmt ling is	gui
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Freq.	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Analysis Accessibility Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Contaminant Analysis Subsurface Issues Model Validation System Performance \text{Vater} Water Soil Engineered Units Fate & Transport Toxicity Contaminant Modeling Fate & Transport Toxicity Contaminant Modeling Fate & Transport Toxicity Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \text{Vater} Facility Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance		Durabili Maintai Monitor Predicti Inspecti Inspect Water Soil Engine	Sensor/ Durabilin Maintair Calibrat Inspectii Inspectii Water Soil Enginee Facility Reportir Reportir Records Cost of Water Soil Enginee Facility Contam Fate & 7 Toxicity Facility Contam Fate & 7 Toxicity Facility	Long 1 Risk Water Soil Engine
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Pertains to non S and T	$ \Box $			
Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ID-S.1.17
NEED TITLE:	Development Of Sensors For Large Scale Measurements In The Vadose Zone To Define Spatial Variability.
PLAIN LANGUAGE:	Need To Develop Indirect Sensors For Large Volume Measurements For Things Like Mositure Content, Pressure And Contaminant Concentration To Enhance Modeling Capability.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting
Relates to final engineered system performance			fion	
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Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Water Soil Engineered Units Facility	ility ainability ainability ation Freq. xtion Cost xtion Cost xnalysis nterpretatif xnalysis sibility tion ds Mgmt fing sered Units y x minant Mo x Transport y y y y y y y y y y y y y y y y y y y	Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durabi Mainta Monitc Predic Inspec Inspec Water Soil Engine		Risk Water Soil Enginee Facility
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED TITLE:	Development Of Indirect Sensing Instrumentation For Spatial Variability Analyses Of State Variables
PLAIN LANGUAGE:	A Method Is Needed To Obtain A Cost-effective Technique To Map Moisture Content, Pressure And Contaminant Concentration Between Boreholes Below Ground.

SCREENING QUESTIONS	1 1							<u>sc</u>	CRE	EN	IIN	G C	ATE	GC	RIES															
Pertains to site maintenance		Waste Form/Physical Barriers		Data Trans			-				1		natior geme	- 1				- 1	Env Sett		ımeı	ntal					- 1	ross		
Relates to final engineered system performance																						tion	<u>.</u>							
Improves data management										_			/dmt	<u>.</u>			eling		ors	sis	(O	nce Validation					guil			
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Better confidence in risk prediction	х																													
Enhances ability to respond to failure in final configuration																														

IEED CODE:	ID-S.1.19
IEED TITLE:	In Situ Biologic Activity Sensor For Vadose Zone And Groundwater Monitoring, Characterization And Remediation.
PLAIN LANGUAGE:	Need To Develop Devices And Instruments To Measure Biological Activity Far Below Ground. Indicates Contaminant Decay To Predict Concentrations At Sites.

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SCREENING QUESTIONS																																		
Pertains to site maintenance		- 11	aste F irriers		Phys	ical					ollect						1		ation emer	nt				- 1	nvir Settir		enta	ıl				Cro Cut	ss ting	
Relates to final engineered system performance													_															_ uoi						•
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Contributes to better understanding of fate and transport	х	Durability	Maintainability Monitoring	Predictability Inspection Freq.	Inspection Cost	: :	Engineered Units Facility	Sensor/Device	Durability Maintains	Maintainability Calibration	nspection Freq.	5	7000	Englineered Orms Facility	Data Analysis	Interpretation	Reporting Accessibility	.ō	s Mgmt Records		Soli Engineered Units Facility	ııty	Contaminant Modeling	₃ <u>⋛</u>		Incertainty Analysis Subsurface Issues	Model Validation	system Performance Nater	of Inite	Engineered Units Facility	Long Term Monitoring		5	Engineered Units Facility
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Better confidence in risk prediction	х																																	
Enhances ability to respond to failure in final configuration																																		

NEED CODE:	nv01-0001-01s
NEED TITLE:	Down Hole Real Time Monitoring Of Radiation(mainly Tritium) In Boreholes
PLAIN LANGUAGE:	An Instrument Is Needed To Perform Daily Low-level Radiation Measurements In Deep Monitoring Wells. Other Needed Measurements Are Temperature, PH, Electrical Conductivity, Water Level, And Total Gamma.

			SCF	REENING CATEGORIES		
SCREENING QUESTIONS						
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					tion	
Improves data management				on Mgmt	eling ors sis sis sis coe Validation	ring
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	vnalysis nterpretatii ting sibility ion ds Mgmt f Records	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \ Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durabili Maintai Monitori Predicta Inspecti Water Soil Enginee Facility	Sensor Durabili Maintai Calibrai Inspect Inspect Water Soil Engined	Data A Pata II Report Acces Retent Recort Cost o Water Soil Engine	Contam Fate & Toxicity Toxicity Ecologii Uncerta Subsurf Model V System Water Soil Enginee	Long 1 Risk Water Soil Engine
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Better confidence in risk prediction	x					
Enhances ability to respond to failure in final configuration						

IEED CODE:	nv02-0001-02S
IEED TITLE:	Deep Well Sampling
PLAIN LANGUAGE:	A Cost-effective Well Design And Sampling Technology Is Needed For Sampling Groundwater For Radionuclides And Other Physical And Chemical Parameters In Deep (up To 1,500 Meters) Wells In Remote Areas.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
Relates to final engineered system performance				
Improves data management			gmt ling is	pui
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Durability Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Soil Cost of Records Mgmt	Facility  Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durabil Maintai Monitor Predicti Inspect Inspect Water Soil Engine	Durabili Maintai Maintai Maintai Calibrat Inspecti Water Soil Eacility Reportit Reportit Record Cost of Water Soil Facility Contam Fate & "Toxicity Ecologiu Uncerta Subsurf Model v	Long Te Risk Water Soil Engined
Pertains to non S and T				
Better confidence in risk prediction	х			
Enhances ability to respond to failure in final configuration				

PLAIN LANGUAGE:	Methods Need To Be Developed To Better Predict The Dynamics Of Collapse Of Void Space, Container/waste Form Degradation, And Subsidence Of Cap Materials.
NEED TITLE:	Long Term Management Of Void Space, Containers, And Cover Subsidence Disposed Waste
NEED CODE:	nv11-0001-08

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers		Cross Cutting
Relates to final engineered system performance	х		igon	
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Device ity nability tion ion Freq. ion Cost in Cost in Cost ion Cost in Cost i	Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction				
Enhances ability to respond to failure in final configuration				

NEED CODE:	nv12-0	0001-06				
NEED TITLE:	Long <sup>-</sup>	Term, Flexible Arid Site Closure	Cover			
PLAIN LANGUAGE:	Develo Neede		e-effective Closure Caps For	Desert Conditions Like Those A	at NTS Is	
SCREENING QUESTIONS	1		sc	REENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	X				tion	
Improves data management				gmt	aling sis sis oce Valida	ring
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Fred.	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units
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Better confidence in risk prediction

Enhances ability to respond to failure in final configuration

NEED CODE:	nv18-0001-07S
NEED TITLE:	Optimizing Monitoring Of Contaminant Transport And Subsidence In The Vadose Zone Of Low Level Radioactive Waste Sites
PLAIN LANGUAGE:	Need To Develop Systems That Can Verify Site Conditions And Provide An Early Warning Of The Rate Of Transport Of Waste Contaminants Along Transport Pathways.

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SCREENING QUESTIONS										1 -																
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Relates to final engineered system performance											_															
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Better confidence in risk prediction	x																									
Enhances ability to respond to failure in final configuration																										

NEED CODE:	ods-i	nt-gjpo-1.1				
NEED TITLE:	Noxio	ous Weed Control				
PLAIN LANGUAGE:	Need	I To Develop More Cost Effectiv	ve, Long Term Noxious Weed	d Control Methods.		
SCREENING QUESTIONS	I	 	sc	REENING CATEGORIES		
Pertains to site maintenance	X	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	X				ition	
Improves data management				gmt	ing s s ve Valida	bu.
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration						

NEED CODE:	ods-	-int-gjpo-1.2				
NEED TITLE:	Long	g-life Signage				
PLAIN LANGUAGE:	Nee	ed For Improved, More Durable S	Signs That Are More Resistar	nt To Weather And Vandalism.		
SCREENING QUESTIONS			<u>sc</u>	REENING CATEGORIES		
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					ttion	
Improves data management				gmt	aling rs is	ing
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X		Sensor Durabili Maintai Maintai Calibra Inspect Inspect Water Soil Engine	Data Au Data In Data In Reporti Record Record Cost of Water Soil Engine Facility	Contam Fate & - Toxicity Toxicity Ecologii Uncerta Subsurf Model V System Vater Soil Enginee	Long Risk Wate Soil Engir
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Enhances ability to respond to failure in final configuration						

PLAIN LANGUAGE:	Need For Improved Physical Barriers And Intrusion Prevention Systems.
NEED TITLE:	Ways To Strengthen Physical Or Institutional Controls
NEED CODE:	ods-int-gjpo-1.3

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting
Relates to final engineered system performance	х		<u> </u>	
Improves data management			Mgmt Mgmt ttors ysis	gui
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	Device by ability ion on Freq on Cost	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X		Sensor/ Durabilir Maintair Calibrat Inspecti Inspecti Nater Soil Braine Reporti Records Cost of Water Soil Enginee Facility Records Contam Fate & Toxicity Ecologic Uncerta Soil Uncerta Soil Contam Fate & Toxicity Ecologic Uncerta Soil Enginee Facility Facility Facility Facility Facility Soil Soil Enginee Facility Facility Facility Facility Soil Facility	Long 7 Risk Water Soil Engine
Pertains to non S and T				X
Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-	int-gjpo-1.4				
NEED TITLE:	Dow	n-hole Monitors				
PLAIN LANGUAGE:	Need	d To Develop An In-situ Monitor	ing Device That Can Anaylze	And Transmit The Data Remote	ely.	
SCREENING QUESTIONS	1	I	sc	REENING CATEGORIES		
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	X				tion	
Improves data management				in t	s s s valida	ng
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durability Maintaina Monitoriny Predictab Inspectior Inspection Water Soil Engineere Facility		Data Analy Data Interp Reporting Accessibilit Retention Records M Cost of Ree Water Soil Engineeree	Contam Fate & Toxicity Toxicity Ecologii Uncerta Subsurf Model V System Water Soil Engline	Long Risk Wate Soil Engin
Pertains to non S and T			x x x x x x			
Better confidence in risk prediction	x					
Enhances ability to respond to failure in final configuration						

NEED TITLE:	Ways To Measure Moisture Flows In Caps
PLAIN LANGUAGE:	Need To Develop A More Cost Effective, Remotely Operated Device To Measure Moisture In/under Caps And Covers.

ods-int-gjpo-1.5

NEED CODE:

	SCREENING CATEGORIES													
SCREENING QUESTIONS														
Pertains to site maintenance	x	Waste Form/Physical Barriers		Cross Cutting										
Relates to final engineered system performance	х													
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NEED CODE:	ods-int-id-1.3
NEED TITLE:	Capability To Monitor Contaminant Movement Within Structures
PLAIN LANGUAGE:	There Is The Need For The Capability To Monitor Structures, Both Internally And Externally, To Ensure Migration Of Contaminants Is Not Occurring And/or To Provide Early Detection.

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NEED CODE:	OGS-INT-IQ-1.4
NEED TITLE:	Policy For Determining Level Of Security For Access Control
PLAIN LANGUAGE:	A Policy Is Needed To Determine The Level Of Security (access Control) Required For An Entombed Facility/structure.

	SCREENING CATEGORIES																										
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Better confidence in risk prediction																											
Enhances ability to respond to failure in final configuration																											

NEED CODE:	ods-int-id-1.5
NEED TITLE:	Uniform DOE Policy For Stakeholder Issues
PLAIN LANGUAGE:	Need For A National Policy That Addresses Stakeholder Concerns About Entombment/d&d Practices That Appy To All Sites Uniformly.

	SCREENING CATEGORIES																							
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Enhances ability to respond to failure in final configuration																								

NEED CODE:	ods-int-id-10.3
NEED TITLE:	Real Time Detection Of Below Ground Releases
PLAIN LANGUAGE:	Need To Develop A Real Time Sensor Device To Detect Below Ground Leaks, Spills, Or Releases Of Contaminants Before Reaching Ground/surface Water.

	SCREENING CATEGORIES													
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NEED TITLE:	Embedded Monioring Devices Or Sensors
PLAIN LANGUAGE:	Need To Develop An Embedded Device To Detect Contamination Releases In High Level Waste Tanks And Storage Structures That Have Been Remediated.

ods-int-id-10.4

NEED CODE:

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Enhances ability to respond to failure in final configuration	x																											

NEED CODE:	ods-int-id-2.1
NEED TITLE:	Better Surveying And Monitoring Devices
PLAIN LANGUAGE:	A Need For Improved Contaminant Monitoring Below A Facility Left In Place And A Method To Detect Possible Subsidence Of Capped Engineered Units.

	SCREENING CATEGORIES														
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SCREENING QUESTIONS	SCREENING CATEGORIES
PLAIN LANGUAGE:	A Need To Develop More Durable Sensors To Monitor Contaminant Movement Below Structures.
NEED TITLE:	More Durable Sensors To Monitor Contaminant Movement
NEED CODE:	ods-int-id-2.2

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NEED CODE:	ods-i	int-id-3.1													
NEED TITLE:	In-sit	tu Samplers To Detect Contami	nant Movement												
PLAIN LANGUAGE:	A Need For In-situ Samplers That Can Detect And Send Data Remotely, With Little/no Human Intervention.														
SCREENING QUESTIONS			SC	REENING CATEGORIES											
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NEED CODE:	ods-int-id-4.1
NEED TITLE:	Long-term Information And Records Management System
PLAIN LANGUAGE:	Need For Long-term Records Management System.

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Enhances ability to respond to failure in final configuration																																							

PLAIN LANGUAGE:	Need Method To Monitor The Impacts Of Changes On Modeling Requirements And Toxicity Data.	

SCREENING QUESTIONS		l _																																		
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Enhances ability to respond to failure in final configuration																																				

NEED CODE:	ods-int-id-6.1
NEED TITLE:	Sensor Array In SDA To Detect Moisture Infiltration
PLAIN LANGUAGE:	Need To Develop A Sensor Array In The Soil Cover Over The Subsurface Disposal Area To Detect Moisture Infiltration.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES		
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able Monitoring Network For Groundwater.

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Enhances ability to respond to failure in final configuration																									

NEED CODE:	ods-int-id-6.3
NEED TITLE:	Leachate Detection And Collection As A Backup System
PLAIN LANGUAGE:	Need To Develop A Leachate Detection/collection Backup System In-situ.

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NEED CODE:	ods-	int-id-6.4				
NEED TITLE:	Impr	oved Closure Cap Cover Desig	n And Monitoring System			
PLAIN LANGUAGE:	Need	d To Design A Closure Cap/cov	er And Monitoring System To	Maintain Integrity Over The Lon	ıg Term.	
SCREENING QUESTIONS	1		<u>sc</u>	REENING CATEGORIES		
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Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration						

NEED CODE:	0ds-Int-Id-7.1
NEED TITLE:	Need To Monitor Groundwater, Ecological Indicators
PLAIN LANGUAGE:	Need To Monitor Groundwater, Ecological Receptors, Soil And Air (rad) Monitoring, Cap Integrity And Moisture, Plant And Animal Intrusion Into Caps.

SCREENING QUESTIONS																<u>sc</u>	CRE	EEI	<u>VIN</u>	G (	<u> </u>	E	OF	IES	<u> </u>														
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NEED CODE:	0us-int-iu-7.2
NEED TITLE:	Need To Determine Cap Durability
PLAIN LANGUAGE:	Need To Improve Cap Durability And A Better Understanding Of Contaminant Retention Rates, Dispersivity Plant Uptake Factors, Bio-accumulation Rates, Fracture Flow Rates, And Boundary Conditions.

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Improves data management																							Mgmt				guile		S	sis			ice Validation				ring			
Contributes to better understanding of fate and transport			Durability Maintainability	Monitoring	redictability	nspection Cost	ī	Engineered Units	ııt)	Sensor/Device	Durability Maintainability	Maintainability Salibration		nspection Cost	in.	Engineered Units	lity	Data Analysis	Data Interpretation	Reporting	Accessibility	Records Mgmt	f Records	'n	Engineered Units	lity	aminant Mode	Fate & Transport	l oxicity Fcological Indicators	Jncertainty Analysis	Subsurface Issues	Model Validation	system Performance Water		Engineered Units		Long Term Monitoring Risk	Ĭ.	( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )	Engineered Units Facility
Involves long term monitoring and surveillance	х		Dura	Mo	Prec	lnsp	Soil	Eng.	Facility	Sen	Dura	Calit	lnsp	dsul **/w	Water Soil	Engi	Faci	Data	Date	Rep	Acce	Rec	Cost	Water	Engi	Facility	Con	Fate	Loxicity  Fcologic	Cuc	Sub	Mod	Systen	Soil	Engine	- L	Long	Water	Soil	Engi Faci
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Better confidence in risk prediction																																								
Enhances ability to respond to failure in final configuration																																								

NEED CODE:	ods-int-id-7.3
NEED TITLE:	Better/cheaper Methods Of Collecting And Analyzing Samples
PLAIN LANGUAGE:	A Need For Real-time Monitoring And Alarms, (e.g., Inline Sensors For Nitrate At INTEC Effluent), Downhole Sensors, And Real-time Monitoring For Air Contaminants. Need For Sensors To Measure Water Leve In Wells (real Time). For Tritium, There Is A Nee

			SCREENING CAT	<u>ATEGORIES</u>
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Informati Managen	
Relates to final engineered system performance				tion
Improves data management				Mgmt deling trors ysis ance Validation toring
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Fecility	Sensor/Device Durability Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt	ds Mgmt if Records eered Unitit minant Mo in Transport y y y y y y y y y y y y y y y y y y y
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Better confidence in risk prediction				
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-int-id-7.4
NEED TITLE:	Groundwater Monitoring Using Electronic Data Transmission
PLAIN LANGUAGE:	Need To Capture Groundwater Data, Unexploded Ordnance Locations, And General Records, And Official Records (including Log Books) In Perpetuity. Need For Comprehensive Site-wide Data Storage System.

			SCRE	ENING CATEGORIES		
SCREENING QUESTIONS						
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					ion	
Improves data management	x			ga	ling is is ce Validation	ing G
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Fred.	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis	Data Interpretation Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \ Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance		Durabil Maintai Monitor Predicti Inspect Inspect Water Soil Engine	Sensor Durabili Maintai Calibrai Inspect Inspect Water Soil Engine Facility	Data Ind Reporting Accessing Record Cost of Water Soil Enginee	Contam Fate & . Toxicity Ecologii Uncerta Subsurf Model V System Water Soil Enginee	Long 7 Risk Water Soil Engine Facility
Surveillance			Х			
Pertains to non S and T						
Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration						

NEED CODE:	ods-ii	nt-id-7.5				
NEED TITLE:	Ecolo	ogical Monitoring, Data Manage	ement			
PLAIN LANGUAGE:	Need	I For Improved Ecological Moni	itoring Capabilities To Detect	Subtle Changes In Ecological In	dicators.	
SCREENING QUESTIONS	1		<u>sc</u>	REENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					tion	
Improves data management				t day	aling rs is ce Validation	ing
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \ Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durability Maintainak Monitoring Predictabil Inspection Inspection Water Soil Engineere Facility	Sensor/Dev Durability Maintainab Calibration Inspection Water Soil Engineerec Facility	Data Anal Data Inter Reporting Accessibil Retention Records N Cost of Re Water Soil Engineere Facility		
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Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration						

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PLAIN LANGUAGE:	Need	For	lmp	)ro\	/ed	We	II D	esiç	gns 1	Το Ι	Enha	and	ce L	₋ong	g Te	erm	W	ell D	ura	bilit	y Ai	nd N	⁄lain	tain	abi	lity.																
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Relates to final engineered system performance	x	-																							J				L					IJ uo				L			_	
Improves data management																								gmt				ling		ပု	s			se validation				ing				
Contributes to better understanding of fate and transport		Durability	Maintainability	Monitoring	Predictability	Inspection Cost	<u>_</u>	10000	Engineered Units Facility		Sensor/Device Durability	Maintainability	Calibration	ection Freq.	Inspection Cost	=	Engineered Units	ıty	Analysis	Data Interpretation	Reporting	Accessibility Retention	Records Mgmt	Cost of Records Mgmt	-	Engineered Units	ıty	Contaminant Modeling	Fate & Transport	roxicity Ecological Indicators	Jncertainty Analysis	Subsurface Issues	Model Validation	System Performance Water		Engineered Units Facility	61	Long Term Monitoring	_	-	Engineered Units	ıty
Involves long term monitoring and surveillance	x		Main	Moni	Pred	Inspe	Water	Soii	Facility	֓֞֜֞֜֜֜֞֜֜֜֜֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓	Sens	Main	Calib	lnspe	Inspe	Soil	Engir	Facility	Data	Data	Repo	Rete	Reco	Cost o	Soil	Engir	Facility	Cont	Fate & T	Ecolor Ecolor	Once	Sabs	Mode	Syster	Soil	Engine					Engir	Facil
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Better confidence in risk prediction	$ \Box $																																									

NEED CODE:	ods-int-id-8.1
NEED TITLE:	Sensors That Can Be Inserted Into Grout
PLAIN LANGUAGE:	Need To Develop In-situ Grout Integrity Sensors.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers		Cross Cutting
Relates to final engineered system performance	x			
Improves data management			on Mgmt deling t toring	
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Freq.	Device lty nability ition ion Freq. ion Cost ion Cost ion Cost analysis ared Unit Records Transpor Transpor Interpretation into Analidation Perform ared Unit area Uni	Water Soil Engineered Units Facility
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				
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SCREENING QUESTIONS	SCREENING CATEGORIES
PLAIN LANGUAGE:	Need To Develop Capability To Quantify Moisture In And Under Covers/caps.
NEED TITLE:	Ways To Quantify Moisture In/under Caps
NEED CODE:	ods-int-id-8.2

CREENING QUESTIONS																														
Pertains to site maintenance		Waste Barrier	Form/Ph s	nysica	al				lection ssion				- 1		matio igeme	- 1				- 1	nvir Settir		nenta	al			- 1	Cross Cutting		
Relates to final engineered system performance	х				_																			l lion			_		_	
Improves data management													_			Mgm			eling		ors i	Si	-	ice Validation			ring			
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring	Predictability Inspection Freq.	Water	soli Engineered Units Facility	sor/Device	Durability Maintainability	Calibration	Inspection Freq.	Je.	Engineered Units Facility	Data Analysis	Data Interpretation Reporting	Accessibility	s Mgmt	Recolds	Soil Engineered Units	lity	Contaminant Modeling	ok Hansport city		Uncertainty Analysis Subsurface Issues	Model Validation	System Performanc Water	Soil Engineered Units	lity	y Term Monitoring	Je	Engineered Units	lity
Involves long term monitoring and surveillance	X	Dura Mair Mon	Prec Insp	Water	Enginee Facility	Sens	Dura	Call	dsul	Water	Engine Facility	Data	Rep	Acce	Rec	Water	Soil	Facility	Con	rate & Toxicity	Ecol	Sub	Mod	Systen	Sol	Facility	Long	Water	Eng.	Faci
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Better confidence in risk prediction	X																													
Enhances ability to respond to failure in final configuration																														

NEED CODE:	ods-int-id-8.3
NEED TITLE:	Probes For Isotopic Measurement
PLAIN LANGUAGE:	Need A Device To Measure Radio-isotopes In-situ.

		SCREENING CATEGORIES													
SCREENING QUESTIONS															
Pertains to site maintenance		Waste Form/Physical Barriers		Cross Cutting											
Relates to final engineered system performance			tition												
Improves data management			Mgmt Mgmt trors vsis ss ss ss rtoring												
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	Device by nability ion on Freq. on Cost ion Cost	Risk Water Soil Engineered Units Facility											
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Better confidence in risk prediction	х														
Enhances ability to respond to failure in final configuration															

NEED CODE:	Ous-Int-ws-1.1
NEED TITLE:	Embedded Radon Sensor
PLAIN LANGUAGE:	Need For A Below Ground Monitor/sensor Device To Detect Radon At The Top Of The Radon Barrie Instead Of At The Surface Of The Cap.

SCREENING QUESTIONS	l 1	l														<u>sc</u>	RE	EΛ	IIN	G C	AT	EG	<u>OR</u>	<u>ES</u>														
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Relates to final engineered system performance	x																						-								tion							•
Improves data management																						Mgmt				ling		ıs	.s		ce Validation				ing			
Contributes to better understanding of fate and transport		ility	Maintainability Monitoring	vioriitoriitig Predictability	nspection Freq.		Soil Engineered Units	y	Sensor/Device	ility	Maintainability Calibration	nspection Freq.	nspection Cost		Engineered Units	λ.	Analysis	Interpretation	ting	Accessibility		f Records		Engineered Units	,	Contaminant Modeling	Transport     Transpor	Ecological Indicators	Uncertainty Analysis	Subsurface Issues Model Validation	System Performance		Engineered Units	<i>&gt;</i> -	Long Term Monitoring			Engineered Units Facility
Involves long term monitoring and surveillance	X	Durability	Maint	Predictabil	Inspe	Water	Soil	Facility	Sens	Durability	Maint	Inspe	Inspe	Water	Engin	Facility	Data	Data	Reporting	Accessibi	Records	Cost o	Soil	Engine	_ a	Conta	Fate & Toxicity	Ecolo	Unce	Mode	Syste	Water	Engin	Facility	Long	Kisk Water	Soil	Engin   Facilit
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Better confidence in risk prediction	х																																					
Enhances ability to respond to failure in final configuration																																						

NEED CODE:	ods-memo-id-1.1
NEED TITLE:	Cost Effective Methods For LTS Monitoring And Surveillance
PLAIN LANGUAGE:	The Need To Evaluate The Use Of In-situ Analyical Techniques Or Remote Monitoring To Replace Current Techniques Of Sampling And Analysis To Reduce Costs.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management Environmental Setting	Cross Cutting
Relates to final engineered system performance			giou	
Improves data management			Mgmt Mgmt tors ysis as ance Validation ance Validation coring	
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Water Soil Engineered Units Facility	The properties of the properti	Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	х	Durabili Maintai Monitor Predicta Inspect Inspect Water Soil Engine		
Pertains to non S and T				
Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-memo-id-1.2
NEED TITLE:	Reliable Risk Assessment Methodology And Fate And Transport Modeling To Support LTS
PLAIN LANGUAGE:	A Need To Reduce The Uncertainty In Risk Predictions To Decrease The Cost Of Stewardship Activities

		SCREENING CATEGORIES											
SCREENING QUESTIONS													
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting							
Relates to final engineered system performance					ion								
Improves data management				gmt	iling rs is	ing							
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \text{Validation} Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility							
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Better confidence in risk prediction	x												
Enhances ability to respond to failure in final configuration													

NEED CODE:	ods-n	ods-memo-id-1.3													
NEED TITLE:	Metho	ods To Support The Integration	n Of Land Management With I	LTS											
PLAIN LANGUAGE:	Need	d To Evaluate The Impact Of Er	nd-state Decisions On Future	Land-use Options.											
SCREENING QUESTIONS			sc	REENING CATEGORIES											
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting									
Relates to final engineered system performance					tion										
Improves data management				gmt	aling rrs sis ice Validation	ring									
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Freq.	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \ Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility									
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Better confidence in risk prediction

NEED CODE:	ods-memo-id-1.4
NEED TITLE:	Engineering Solutions For Permanent Control Of Residual Contamination And Waste Left In Place
PLAIN LANGUAGE:	Need For A Better Understanding Of Long-term Performance Of Engineered Solutions.

		SCREENING CATEGORIES																		
SCREENING QUESTIONS																				
Pertains to site maintenance		Waste Form/Physical Barriers			Collection mission	/		Informa Manage				- 1	viron tting	nmen	tal			Cro Cut		
Relates to final engineered system performance	х								_						lion					
Improves data management									gmt		gling	ç	<u>.</u> .≅		ce Validation		ing	,		
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil	2	Sensor/Device Durability Maintainability	Calibration Freq. Inspection Cost Water	Soil Engineered Units Facility	Data Analysis Data Interpretation	Reporting Accessibility Retention	Cost of Records Mgmt Water	Soil Engineered Units Facility	Contaminant Modeling	ity	Dicertainty Analysis	Subsurface Issues Model Validation	System Performan Water	Soil Engineered Units Facility	Term Monitoring		:	Engineered Units Facility
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Better confidence in risk prediction																				
Enhances ability to respond to failure in final configuration																				

NEED CODE:	ods-memo-id-1.5													
NEED TITLE:	Stron	g Cost Estimating Tools For L	тѕ											
PLAIN LANGUAGE:	A Ne	ed For Better Tools For Defens	sible Life-cycle Cost Estimate	s For LTS.										
SCREENING QUESTIONS	I I		<u>sc</u>	CREENING CATEGORIES										
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting								
Relates to final engineered system performance					tion									
Improves data management				jmt	ing s s se Valida	DU D								
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units								
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Better confidence in risk prediction														
Enhances ability to respond to failure in final configuration														

NEED CODE:	ods-memo-id-1.6													
NEED TITLE:	Tools F	or The Management For Info	rmation Of Future Generation	ns										
PLAIN LANGUAGE:	Need T	o Develop Tools To Ensure I	nformation Management And	Transfer To Future Generations	i.									
SCREENING QUESTIONS			<u>sc</u>	REENING CATEGORIES										
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting								
Relates to final engineered system performance					ion									
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility								
Involves long term monitoring and surveillance		Durabil Maintai Moniton Predict Inspect Inspect Water Soil Engine	Sensor Durabil Maintai Calibra Inspect Inspect Water Soil Engine		Contam Fate & T Toxicity Ecologiic Uncerta Subsurf Model V System Water Soil Enginee Facility	Long Risk Wate Soil Engir								
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Better confidence in risk prediction														
Enhances ability to respond to failure in final configuration														

NEED CODE:	ods-memo-oh-1.1	ds-memo-oh-1.1					
NEED TITLE:	Long Term Record Kee	ping And Retrievability					
PLAIN LANGUAGE:	Need To Develop A Re	d To Develop A Record Keeping System That Is Easily Accessed And Maintained.					
SCREENING QUESTIONS	I		SCREENING CA	TEGORIES			
SCREENING QUESTIONS							
Pertains to site maintenance	Waste Form/Ph	ysical Data Collectio Transmission	n/ Informat Manager		Environmental Setting	Cross Cutting	
Relates to final engineered system performance					tion		
Improves data management	x			±	Valida		
Contributes to better understanding of fate and transport	Durability Maintainability Monitoring Predictability Inspection Freq.	Water Soil Engineered Units Facility Sensor/Device Durability Maintainability Calibration Inspection Freq.	water Soil Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mmmt	Contaminant Modeling	Fate & Transport Toxicity Toxicity Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units	
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Better confidence in risk prediction

NEED CODE:	ods-memo-oh-1.10
NEED TITLE:	Remote Sensing And Monitoring Of Vegetation
PLAIN LANGUAGE:	Need To Develop Remote Sensing Technology To Monitor Long Term Health Of Vegetation On Disposal Facility Covers And Ecosystem.

			<u>SC</u>	REENING CATEGORIES		
SCREENING QUESTIONS						
Pertains to site maintenance	х	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	х				igon	
Improves data management				on Mgmt s	eling rrs is ce Validation	ing
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Feacility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	vnalysis nterpretatii ing sibility ion ds Mgmt f Records	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	х	Durability Maintaina Maintaina Monitorin Predictab Inspectior Inspectior Vater Soil Engineere Facility	Sensor/De Durability Maintainal Calibration Inspection Water Soil Engineere Facility	Data Ana Data Inte Reportin Accessib Retentio Records Cost of F Water Soil Engineer	Contam Fate & 1 Toxicity Ecologic Uncerta Subsurf Model V System Water Soil Enginee	Long 7 Risk Water Soil Engine Facility
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Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration						

NEED CODE:	ods-r	ods-memo-oh-1.11																							
NEED TITLE:	Integ	rated Real Tin	ne Sensor An	d Da	ta Tr	ansm	issior	n Sys	tem																
PLAIN LANGUAGE:	Need	To Develop I	ntegrated Sys	stem	То С	ollec	t, Stor	re An	d Tran∈	smit C	ata	In Re	eal T	me.											
SCREENING QUESTIONS									<u>s</u>	CREE	NIN	IG C	ATE	GOI	RIES										
Pertains to site maintenance		Waste Forn Barriers	m/Physical				ollecti				- 1	nforn Mana		- 1			- 1	nviror	nmenta	al			1 -	oss utting	
Relates to final engineered system performance	х		_								_			_						_ noi					_
Improves data management	х										_		100			eling		ors sis		ice Validation		,	Bul		
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability	Inspection Freq. Inspection Cost Water Soil Engineered Units	ity	Sensor/Device Durability	Maintainability Calibration	Inspection Freq.	<u>_</u>	Engineered Units Facility	Data Analysis	Data Interpretation Reporting	Accessibility Retention	Records Mgmt		Engineered Units Facility	Contaminant Modeling	ity	Ecological Indicators Uncertainty Analysis	Subsurface Issues Model Validation	System Performance Water	Soil Engineered Units Facility	8	l erm Monitoring	Water Soil	neered Units
Involves long term monitoring and	X	Dura Main Moni Predi	Inspec Inspec Water Soil Engine	Facility	Sens	Main	lnspe Inspe	Water	Engii Facil	Data	Repo	Acce	Reco	Water	Engir Facili	Cont	Toxicity	Unce	Subs	Systen	Soil Engine Facility		Long ler Risk	Wate	Engi

surveillance

Pertains to non S and T

Better confidence in risk prediction

NEED CODE:	ous-memo-on-1.12
NEED TITLE:	Automated X-ray System To Examine Disposal Cell
PLAIN LANGUAGE:	Need To Develop Automated System To Examine Contents Of Disposal Cell Post Closure.

			sc	CREENING CATEGORIES		
SCREENING QUESTIONS						
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	х				ion	
Improves data management				gmt	eling irs is ice Validation	gui
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \ System Performance \ Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration	х					

NEED CODE:	ods-memo-oh-1.13
NEED TITLE:	Real-time Leachate Detection And Measurement System
PLAIN LANGUAGE:	Need To Develop A Real-time, Monitoring And Sensing System To Determine The Integrity Of Leachate Collection Systems And Detect Leaks In Collection System Lines.

SCREENING QUESTIONS	I I		<u>sc</u>	REENING CATEGORIES		
Pertains to site maintenance	х	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	х				ion	
Improves data management				gmt	ling rs is ce Validation	gui.
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Fracility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \ Water Soil	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	x	Durability Maintaina Manitoring Monitoring Predictabi Inspection Water Soil Engineere Facility	Sensor/De Durability Maintainat Calibration Inspection Inspection Water Soil Engineere	Data Analy Data Interpressibility Reporting Accessibility Retention Records IV Cost of Re Water Soil Engineere	Contam Fate & Toxicity Toxicity Ecologii Uncerta Subsurt Water Soil Enginee Facility	Long 7 Risk Water Soil Engine
Pertains to non S and T	$ \Box $		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			x x x
Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration	х					

NEED CODE:	ods-	ods-memo-oh-1.14					
NEED TITLE:	Pass	sive Treatment Of Leachate					
PLAIN LANGUAGE:	Need	d To Develop A Process For Th	e Passive Treatment Of Leac	hate.			
SCREENING QUESTIONS	ı	I	sc	REENING CATEGORIES			
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting	
Relates to final engineered system performance	X				tion		
Improves data management				lm t	ing s s S Se Valida	bu	
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility	
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Better confidence in risk prediction							
Enhances ability to respond to failure in final configuration	х						

NEED CODE:	ods-	ds-memo-oh-1.2						
NEED TITLE:	Lead	chate Collection And Transmission Line Maintenance						
PLAIN LANGUAGE:	Nee	ed To Develop Automated Techn	oology To Unplug Leachate Co	ollection And Transmission Line	S.			
SCREENING QUESTIONS	1	ĺ	sc	REENING CATEGORIES				
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting		
Relates to final engineered system performance					ation			
Improves data management				r Agmt	eling ors sis s	oring		
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units		
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Pertains to non S and T								
Better confidence in risk prediction								
Enhances ability to respond to failure in final configuration								

NEED CODE:	ods-memo-oh-1.3					
NEED TITLE:	Automated Security System					
PLAIN LANGUAGE:	eed To Develop An Automated Security System.					
SCREENING QUESTIONS	I	SCF	REENING CATEGORIES			
Pertains to site maintenance	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting	
Relates to final engineered system performance				LO		
Improves data management			Mgmt	leling tors sis s nnce Validati	oring	
Contributes to better understanding of fate and transport	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility	
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Better confidence in risk prediction						

NEED CODE:	ods-memo-oh-1.4
NEED TITLE:	Perimeter Groundwater Well Monitoring
PLAIN LANGUAGE:	Need To Develop Automated Technology To Monitor Perimeter Groundwater Wells To Determine Elevation Of Water, Detect Contaminants, Etc.

	SCREENING CATEGORIES																				
SCREENING QUESTIONS																					
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Relates to final engineered system performance			_								_										
Improves data management										amt	1		ling	હ	.s	ce Validation			ing		
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq.	Soil Engineered Units Facility	Sensor/Device Durability	Viaintainability Calibration nspection Freq.	Inspection Cost Water Soil	Engineered Units Facility	Data Analysis Data Interpretation	Reporting Accessibility	Retention Records Mgmt Cost of Records Mamt		Engineered ornis Facility	Contaminant Modeling Fate & Transport	Toxicity Ecological Indicators	Uncertainty Analysis Subsurface Issues	Model Validation System Performance	<b>L</b>	Engineered Units Facility	Long Term Monitoring	ī	Soil Engineered Units Facility
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surveillance			ПП	ПТ	TTT	TT	ПП			П	ПП	П			Х	Х	хII	х	П	П	
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Better confidence in risk prediction	x																				
Enhances ability to respond to failure in final configuration																					

NEED CODE:	ods-memo-oh-1.5
NEED TITLE:	Monitoring Biological/chemical Properties Of Ponds And Streams (Paddy's run)
PLAIN LANGUAGE:	Need To Develop Automated Method For Monitoring Bilogical And Chemical Properties Of Ponds And Streams (Paddy's Run)

CODEENING OLIECTIONS	1 1	SCREENING CATEGORIES											
SCREENING QUESTIONS													
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting									
Relates to final engineered system performance			gig grant and the state of the										
Improves data management			Mgmt Adeling t trors ss svsis es ance Validation ance Validation										
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Better confidence in risk prediction	x												
Enhances ability to respond to failure in final configuration													

NEED CODE:	ods-	-memo-oh-1.6				
NEED TITLE:	Auto	omated Meteorological Monitori	ing Stations			
PLAIN LANGUAGE:	Nee	d To Construct Real Time Auto	omated Meteorological Monitori	ing Stations.		
SCREENING QUESTIONS		1	sc	REENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					tion	
Improves data management				igmt	eling ors sis ince Validation	ring
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction

Enhances ability to respond to failure in final configuration

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NEED CODE:	ods-memo-oh-1.7
NEED TITLE:	Disposal Facility Physical Change Monitoring System
PLAIN LANGUAGE:	Need To Develop Technology To Measure Physical Changes And Differential Subsidence In Disposa Facilities.

COREENING OUESTIONS	1 1	SCREENING CATEGORIES											
SCREENING QUESTIONS													
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Env Sett	ironmental Cross Cutting									
Relates to final engineered system performance	x												
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Surveillance	l l	x x x x x x x x											
Pertains to non S and T													
Better confidence in risk prediction													
Enhances ability to respond to failure in final configuration	x												

PLAIN LANGUAGE:	Need To Develop Automated Method To Detect Penetrations Or Intrusions Of Water/moisture O Groundwater Into Disposal Facilities.
NEED TITLE:	Detection Of Penetrations In Disposal Facilities
NEED CODE:	ods-memo-oh-1.8

	SCREENING CATEGORIES											
SCREENING QUESTIONS												
Pertains to site maintenance	х	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting						
Relates to final engineered system performance	х				jon							
Improves data management				gmt	ling rs is ce Validation	ing						
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Better confidence in risk prediction												
Enhances ability to respond to failure in final configuration	х											

NEED CODE:	ods-memo-on-1.9
NEED TITLE:	Detection Of Erosion And Runoff
PLAIN LANGUAGE:	Need To Develop Automated Technology To Detect, Measure And Monitor Erosion And Runoff From Remediated Areas And Disposal Facilities.

	SCREENING CATEGORIES											
SCREENING QUESTIONS												
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Fransmission Information Management Setting	Cross Cutting								
Relates to final engineered system performance	x		<u> </u>									
Improves data management			gmt ling lis is	Di.								
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water Soil	Facility Long Term Monitoring Risk Water Soil Engineered Units Facility								
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Better confidence in risk prediction	$ \Box $											
Enhances ability to respond to failure in final configuration	x											

PLAIN LANGUAGE:	There Is A Need For LTS Data Standards For Storage And Use.
NEED TITLE:	LTS Data And Information Management Needs From The Working Draft
NEED CODE:	ods-rep-2

SCREENING QUESTIONS						<u>sc</u>	CREEN	ING CATE	GORIES								
Pertains to site maintenance		Waste Form/Physical Barriers			Collection smission	n/		Information Manageme	1		Envi Setti	ronmer	ital			Cross Cuttin	
Relates to final engineered system performance															ָ֖֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֓֓֓֡֓֓֓֡֓֡		_
Improves data management	х							Mag	= 5	ling	ន	<u> </u>	ce Validation		ling		
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water	Engineered Units Facility	Sensor/Device Durability Maintainability	ation tion Freq. tion Cost	Nater Soil Engineered Units =acility	Analysis Interpretation	ity Igmt	ered Units	Contaminant Modeling Fate & Transport	Foxicity Ecological Indicators	Uncertainty Analysis Subsurface Issues Model Validation	System Performance	soll Engineered Units Facility	Long Term Monitoring		Soil Engineered Units Facility
Involves long term monitoring and surveillance		Durability Maintainab Monitoring Predictabili Inspection Inspection Water Soil	Engine	Sensor/De Durability Maintainal	Calibration Inspection Inspection	Soil Engine Facility	Data A Data Ir	Reporting Accessibili Retention Records M	Water Soil Engined	Contar Fate &	Toxicity	Subsu Model	Systen	Soll Engine Facility	Long T	Risk Water	Engine Facility
Pertains to non S and T							x x	x x x x x	(   x	Ш				Ш			Ш
Better confidence in risk prediction																	
Enhances ability to respond to failure in final configuration																	

NEED CODE:	oas-rep-3.1
NEED TITLE:	Better Tools For In-situ Field Measurement
PLAIN LANGUAGE:	Identifies The Need For Better Tools (e.g. In-situ Field Measurement) To Characterize And Accurately Predict (model) Contamination Movement Below Ground.

SCREENING OLIESTIONS			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance	$ \Box $	Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
Relates to final engineered system performance			ioi	
Improves data management			gmt sling is ce Validation	n =
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Nater Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Freq. Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance v Water Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Units Facility Long Term Monitoring	e ered
Involves long term monitoring and surveillance	x	Durability Maintaina Monitoring Predictabi Inspection Inspection Water Soil Engineere Facility		Risk Water Soil Engine
Pertains to non S and T	$ \Box $			
Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-rep-3.2
NEED TITLE:	Improved Interagency Coordination
PLAIN LANGUAGE:	Need For Improved Interagency Coordination Among 18 Specific Research Programs On Hazardous Chemicals And Heavy Metals Directly Related To EM Science Program And DOE Cleanup.

SCREENING OLIESTIONS	1 1		SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
Relates to final engineered system performance			igou in the state of the state	
Improves data management			is visa visa visa visa visa visa visa vi	<b>B</b>
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Cost Nater Soil Engineered Units Facility	The habi	Long lerm Montoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	$ \Box $	Durability Maintainal Monitoring Predictabi Inspection Inspection Water Soil Engineere Facility	Sensor/De Durability Maintainal Calibration Inspection Water Soil Engineere Facility Accessibil Reporting Accessibil Retention Records N Cost of Re Water Soil Engineere Facility Contamina Fate & Tre Toxicity Contamina Subsurfac Model Val System P Soil Soil System P Soil Soil Soil Subsurfac Model Val System P Soil	Long Risk Water Soil Engine
Pertains to non S and T	x			
Better confidence in risk prediction	$ \Box $			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-	s-rep-3.3				
NEED TITLE:	Lon	ng-term Emphasis Of Researd	ch Focus			
PLAIN LANGUAGE:	Con		nphasize Four Research Areas: ? ace, 2) Conceptual Modeling, 3) (			
SCREENING QUESTIONS	1	1	sc	CREENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance		]			ition	
Improves data management		וןנ		gmt	ing s s validation	. Buj
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil	Sensor/Device Surability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance N Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance		Durability Maintaina Monitoring Predictab Inspection Inspection Water Soil Engineere	Sensor/De Durability Maintainol Maintainol Inspection Water Soil Engineere	Data Al Data In Reporti Access Record Cost of Water Soil Engine Facility	Contam Fate & 1 Toxicity Ecologi Uncerta Subsurf Model V System Water Soil Enginee	Long Risk Wate Soil Engir
Pertains to non S and T	х	] [				
Better confidence in risk prediction		]				
Enhances ability to respond to failure in final configuration		]				

NEED CODE:	ods-r	rep-3.4																																	
NEED TITLE:	Meth	ods To	Valid	ate C	Conta	ainme	ent A	nd S	Stab	ilizat	tion																								
PLAIN LANGUAGE:	A Ne	ed For	Metho	ods T	ō Vá	alidat	e Co	ontaii	nme	ent A	and :	Stab	oiliza	ation :	Syst	tems	s To	Ens	sure	Lor	ng-te	rm F	rote	ectic	on.										
SCREENING QUESTIONS	I	I												<u>sc</u>	RE	EN	ING	CA	TE	GO	RIE	<u>s</u>													
Pertains to site maintenance		1 11	ste Fo	rm/Pl	nysic	al				a Co nsmi							ı		ation emer	- 1						viror	nmer	ntal					ross		
Relates to final engineered system performance	X																											ion							
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Involves long term monitoring and surveillance	X	Dura			Water		_	Sen	Dura	Cali	dsul	Wat	Soil	Facility	Data	Data	Kep Acc	Rete	Rec	Water	Soil	Faci	Con	Fate	Tox	ou'D	Sub		Water		Facility	Long	Water	Eng	Faci
Pertains to non S and T			хх		Ш	Х	Ш			<u> </u>				Ш					<u> </u>			Ш	Ш					Х		х	]		<u> </u>	Ш	_
Better confidence in risk prediction																																			
Enhances ability to respond to																																			

PLAIN LANGUAGE:	Need To Develop Methods For Designing Monitoring Systems To Detect Both Current Conditions And Changes In System.
NEED TITLE:	Methods For Designing Monitoring Systems To Detect Current Conditions And Changes
NEED CODE:	ods-rep-3.5

SCREENING QUESTIONS	l I		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management Environmental Setting	Cross Cutting
Relates to final engineered system performance	х		giou	
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Theorice ity nability ition cost ion Crost ion Cost ion Cost ion Cost ion Cost in allysis terpretation on ion in any signification in any signification in any in a	Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction	$ \Box $			
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-rep-3.6		
NEED TITLE:	Research Dealing With Transuranic Contaminants	Involving Metals And Radionuclide	
PLAIN LANGUAGE:	Need Specific Research Dealing With Transuranic	Contaminants Involving Metals And Radionuc	ilides.
SCREENING QUESTIONS		SCREENING CATEGORIES	
Pertains to site maintenance	Waste Form/Physical Data Colle Transmiss		Environmental Cross Cutting
Relates to final engineered system performance			, , , , , , , , , , , , , , , , , , ,
Improves data management		gm	aling
Contributes to better understanding of fate and transport	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Maintainability Calibration Inspection Freq.	Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \( \) Water Soil Engineered Units Facility Long Term Monitoring Risk Water Soil Engineered Units Facility Facility Facility Facility Facility Facility
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surveillance

Pertains to non S and T

Better confidence in risk prediction

Enhances ability to respond to failure in final configuration

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NEED CODE:	ods-rep-3.7
NEED TITLE:	Integration Of Research Community To Broaden Community Of Researchers
PLAIN LANGUAGE:	Need To Integrate Research From Government Agencies With Research Capabilities, National Laboratories, Universities, And Industry.

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SCREENING QUESTIONS																											
Pertains to site maintenance		Waste Form/Physical Barriers				llection				- 1		matic agem	- 1				- 1	Env Sett		men	tal				Cros Cutti	_	
Relates to final engineered system performance										-			_				_				lion —						
Improves data management													ls Mgmt			guile		ors	sis		ice Validation			ring			
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	or/Device	sensor/Device Durability	Maintainability Calibration	Inspection Freq. Inspection Cost	_	Engineered Units Facility	Data Analysis	Data Interpretation Reporting	Accessibility	on s Mgmt	Record	pered Unite	Facility	Contaminant Modeling	& Transport	Ecological Indicators	Jncertainty Analysis	Subsurface Issues Model Validation	System Performance	_	Engineered Units Facility	Long Term Monitoring	_	ation I boroom	Engineered Units Facility
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Pertains to non S and T	x		] [								П												Ш				П
Better confidence in risk prediction	$ \Box $																										
Enhances ability to respond to failure in final configuration																											

NEED CODE:	ods-rep-4.1
NEED TITLE:	Develop Integrated Solution With Regards To Present And Future Technologies
PLAIN LANGUAGE:	Need To Identify Present And Future Subsurface Technologies, Technology Gaps, And Combining Them For An "integrated Solution".

		SCREENING CATEGORIES	
	Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting
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	oility cainability coring ctability ction Freq. ction Cost r	or/Device oil/Device oility tation ction Freq. ction Cost r r Analysis Interpretation rating sibility rition rds Mgmt of Records M aminant Mode & Transport rition aminant Mode subside Indicato r r r r Analysis sibility rition rds Mgmt of Records M astility rition rds Mgmt reered Units r r r r r r r r r r r r r r r r r r r	eered V
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SCREENING QUESTIONS	SCREENING CATEGORIES
PLAIN LANGUAGE:	A Better Understanding Of Below Ground Characterization, Prediction, And Monitoring.
NEED TITLE:	Full Capabilities Of Vadose Zone Characterization, Prediction, And Monitoring
NEED CODE:	ods-rep-4.2

SCREENING QUESTIONS																						
Pertains to site maintenance		Waste Form/P Barriers	Physical			Collect				1	mation agemer	- 1			Env Sett	ironm ing	enta	al			Cross Cuttin	
Relates to final engineered system performance				'								_					!	_ uoi:				
Improves data management											qmt			eling	ors	sis	>	ice Validation		ring		
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability inspection Freq.	Inspection Cost Water Soil Engineered Units Facility	Sensor/Device	Durability Maintainability	Calibration Inspection Freq.		Engineered Units Facility	Data Analysis Data Interpretation	Reporting Accessibility	Retention Records Mgmt Cost of Records Mamt	Į.	Engineered Units Facility	Contaminant Modeling Fate & Transport	Toxicity Ecological Indicators	Uncertainty Analysis Subsurface Issues	alid ,	em Pertorman er	Engineered Units Facility	J Term Monitoring	Į.	Soil Engineered Units Facility
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Better confidence in risk prediction	Х																					
Enhances ability to respond to failure in final configuration																						

NEED CODE:	ods-rep-4.3	
NEED TITLE:	Better Analysis And Assessment Stages For Repository Sites	
PLAIN LANGUAGE:	Need For An Improved Repository Design That Creates No Undue Future Risks.	
SCREENING QUESTIONS	SCREENING CATEGORIA	<u>ES</u>
Pertains to site maintenance	Waste Form/Physical Data Collection/ Transmission Information Management	Environmental Cross Setting Cutting
Relates to final engineered system performance		5
Improves data management		ing se Validation
Contributes to better understanding of fate and transport	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Calibration Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil	Facility  Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \text{Validation} System Performance \text{Validation} Soil Engineered Units Facility  Long Term Monitoring Risk Water Soil Engineered Units Facility Facility Facility Facility Facility
Involves long term monitoring and surveillance		Facility  Contarr  Fate & Toxicity  Contarr  Fate & Toxicity  Cologia  Uncerta Subsur  Model \ System  Water  Soil  Engine  Facility  Risk  Water  Soil  Engine Facility
Pertains to non S and T		
Better confidence in risk prediction		

Enhances ability to respond to failure in final configuration

NEED CODE:	ods-rep-4.4
NEED TITLE:	Validation Data Through Model Adjustments
PLAIN LANGUAGE:	A Need For Site Characterization Data To Validate Model Predictions.
SCREENING QUESTIONS	SCREENING CATEGORIES  Wasta Form/Physical Data Collection/ Information Environment

SCREENING QUESTIONS															_																				
Pertains to site maintenance		- 11	ste F		Phys	sical					ollec		/				- 1		natio					- 1	Env Sett			ıtal				- 1	Cros:	-	
Relates to final engineered system performance							'						_								-			•					•			_			
Improves data management																				Mgmt			guile		ſS	is		ce Validation				ing			
Contributes to better understanding of fate and transport	х	Durability	Maintainability Monitoring	Predictability Inspection Freq.	Inspection Cost		Engineered Units Facility	Sensor/Device	Durability	vaintainability Calibration		nspection Cost Vater		Engineered Units Facility		Data Analysis Data Interpretation	Reporting	Accessibility Retention	ords Mgmt	Records	<del>-</del> 5	Engineered Units Facility	Contaminant Modeling	Fate & Transport	roxicity Ecological Indicators	Uncertainty Analysis	Subsurface Issues	System Performan	<b>5</b>	Engineered Units	ıţ	J Term Monitoring	٦.	Soil Engineered Units	ity
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Pertains to non S and T															] [				Ш				Х	х			хх		Х	П			Ш		
Better confidence in risk prediction	х																																		
Enhances ability to respond to failure in final configuration																																			

NEED CODE:	ods-	rep-4.5				
NEED TITLE:	Nee	d For Predicting Contaminant T	ransport Through The Vadose	e Zone		
PLAIN LANGUAGE:	Nee	d To Predict Contaminant Trans	sport Below Ground Using A T	Γhree-step Iterative Process.		
SCREENING QUESTIONS	1	1	<u>sc</u>	REENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					ioi	
Improves data management				gm	iling rs is ce Validation	gui
Contributes to better understanding of fate and transport	х	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Pertains to non S and T						
Better confidence in risk prediction	X					
Enhances ability to respond to failure in final configuration						

NEED CODE:	ods-rep-4.6
NEED TITLE:	Field Scale Research
PLAIN LANGUAGE:	Need To Use Field Data Gathered Over Long Periods Of Time To Accurately Predict Contaminant Movement And Behavior.
SCREENING QUESTIONS	SCREENING CATEGORIES

SCREENING QUESTIONS																													
Pertains to site maintenance		Waste Barrie		Physic	cal		1		llection						rmatic agem	- 1				- 1	nviro	nmei	ntal				Cros		
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Improves data management																gmt			eling		ors sis		ice Validation			ring			
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring	Predictability nspection Freq.	nspection Cost Nater	Soil Engineered Units Facility	Sensor/Device	Durability Maintainability	Calibration	nspection Freq. nspection Cost	<u>.                                    </u>	Engineered Units Facility	Data Analysis	Data Interpretation	Reporting Accessibility	Retention Records Mgmt	Cost of Records Mgmt Water	Soil Engineered Units	ty	Contaminant Modeling Fate & Transport	. if	-cological Indicators Jncertainty Analysis	. g :	ar validation em Performan	<u>.</u>	Engineered Units Facility	Term Monitoring		Soil	Teered Cillis
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Pertains to non S and T								П					П		Ш				хх			ΧD		х	Ш	Х	X	X	I
Better confidence in risk prediction	x																												
Enhances ability to respond to failure in final configuration																													

NEED CODE:	ods-rep-4.7
NEED TITLE:	Ambient Monitoring, Performance Monitoring And Detection Monitoring
PLAIN LANGUAGE:	A Complete Long Term Monitoring System Includes The Need For Ambient, Performance, And Detection Monitoring.

	SCREENING CATEGORIES									
SCREENING QUESTIONS										
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting						
Relates to final engineered system performance	x		tion							
Improves data management			Mgmt Mgmt ttors vsis s s rtors vsis s s rtoring							
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	in ability in a bility in a bility it in a bility it in Cost in Cost in Cost in a bility on a s Mgmt in a bility on a s Mgmt in a bility on a s Mgmt in a s Mgmt in a bility on a s Mgmt in a bility on a s Mgmt in a bility and in a bility a	Risk Water Soil Engineered Units Facility						
Involves long term monitoring and surveillance	х			Risk Water Soil Enginee						
Pertains to non S and T	$ \Box $									
Better confidence in risk prediction	x									
Enhances ability to respond to failure in final configuration										

PLAIN LANGUAGE:	Need For Improved, Cost Effective, Monitoring And Surveillance Techniques.
NEED TITLE:	Cost Effective Monitoring And Surveillance Techniques
NEED CODE:	ods-rep-8-nm-1.1

SCREENING QUESTIONS			SCREENING CATEGORIES	
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management	Environmental Cross Cutting
Relates to final engineered system performance				5.5
Improves data management			Mgmt	ling rs is ce Validation ing
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	oility  Freq. Cost Cost Vsis pretatii	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \text{Validation} System Performance \text{Validation} Soil Engineered Units Facility  Long Term Monitoring Risk Water Soil Engineered Units Facility Facility Facility Facility Facility
Involves long term monitoring and surveillance	x	Durability Maintainab Monitoring Predictabili Inspection Inspection Vater Soil Engineered Facility	Sensor/De Durability Maintainab Calibration Inspection Inspection Water Soil Engineere Facility Data Analy Data Interp Reporting Accessibility Records M Cost of Ree Water Soil Engineere Soil	Contam Fate & 1 Toxicity Ecologic Uncertal Subsurf Model V System Water Soil Enginee Facility Long Te Risk Water Soil Enginee Facility
Pertains to non S and T				
Better confidence in risk prediction				
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-rep-8-tn-1.1
NEED TITLE:	Enhanced Reliability Of Engineered Controls
PLAIN LANGUAGE:	Need For Improved Ability To Predict And Assess Long-term Performance Of Engineered Controls (isolation Caps And Trenches, Reactive Barriers, Etc) And Monitoring Systems.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance	х	Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
Relates to final engineered system performance	х		tion	
Improves data management			Mgmt Mgmt t trors ysis as ance Validation forma	n =
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Feacility	Ity Pevice lity inability attion Cost tion Cost tion Cost tion Cost tion Cost inability in Cost inability in Cost Ity Co	ered /
Involves long term monitoring and surveillance	x	Durability Maintaina Monitorin, Monitorin, Inspection Inspection Inspection Soil Engineere Facility	Sensor/D Durability Maintains Calibratic Inspectio Water Soil Engineer Facility Cost of R Water Soil Engineer Facility Accessib Retentior Records Cost of R Contamir Facility Contamir Fate & Ti Toxicity Ecologic Uncertair Subsurfa Model Ve Soil Engineer Facility Contamir Fate & Ti Toxicity Ecologic Uncertair Subsurfa Model Ve Soil Engineer Facility	Risk Water Soil Engine
Pertains to non S and T				
Better confidence in risk prediction				
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-rep-8-tn-1.3
NEED TITLE:	Remote Monitoring Techniques
PLAIN LANGUAGE:	The Need For Remote Monitoring Of Caps, Covers And Trenches To Detect Failures, Possibly Using Satellite Technology.

SCREENING QUESTIONS	1 1		SCREENING CATEGORIES	
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Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Information Environmental Transmission Management Setting	Cross Cutting
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Improves data management			Igmt Igmt Igms Igms Igms Igms Igms Igms Igms Igms	ring
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Analysis Accessibility Reporting Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility Contaminant Modeling Facility Contaminant Modeling Contaminant Modeling Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance V	Soil Engineered Units Facility Long Term Monitoring Risk Water Soil Engineered Units Facility
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surveillance				x x x
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Better confidence in risk prediction	х			
Enhances ability to respond to failure in final configuration	х			

NEED CODE:	ods-rep-8-tn-1.5
NEED TITLE:	Insitu Biological Monitoring To Replace Analytical Monitoring
PLAIN LANGUAGE:	Need For Insitu Biological Monitoring To Supplement And Eventually Replace Traditional Analytica Monitoring.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers		Cross Cutting
Relates to final engineered system performance			l l l l l l l l l l l l l l l l l l l	
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Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Reporting Accessibility Retention Reporting Accessibility Retention Reporting Accessibility Retention Records Mgmt Cost of Records Mg	Nisk Water Soil Engineered Units Facility
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Pertains to non S and T				x
Better confidence in risk prediction				
Enhances ability to respond to failure in final configuration				

NEED CODE:	ods-rep-emsp-1.1
NEED TITLE:	Contaminant Monitors And Diagnostic Parameters
PLAIN LANGUAGE:	Need To Develop Improved Sensors And Define Diagnostic Parameters To Identify And Characterize The Presence Of Contaminants In All Media.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES		
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance				ation	
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Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	oility Thead. Cost Cost ysis pretatifity ity d Units	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance N Mater Soil	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	х	Durability Maintaina Monitorin, Predictab Inspectior Inspection Water Soil Engineere	Sensor/De Durability Maintainal Calibration Inspection Water Soil Engineere Facility Data Anal Data Intert Reporting Accessibil Retention Records A Cost of Re Water Soil Engineere	Contam Fate & - Toxicity Ecologii Uncerta Subsurf Model V System Water Soil Enginee	
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Better confidence in risk prediction	x				
Enhances ability to respond to failure in final configuration					

NEED CODE:	ods-rep-emsp-1.2
NEED TITLE:	Sensors To Monitor Physical Integrity Of Barriers, Structures And Landfills
PLAIN LANGUAGE:	Need To Develop Improved Sensors To Monitor Physical Integrity Of Barriers, Structures And Landfills Post- closure.

SCREENING OUESTIONS	1 1		sc	CREENING CATEGORIES		
SCREENING QUESTIONS						
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance	x				ion	
Improves data management				on Mgmt	aling rrs is ce Validation	ing
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Fred.	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	nalysis terpretatii ng no no s Mgmt Records	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \( \) Water Soil Engineered Units Facility	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durabili Maintai Monitor Predicta Inspecti Inspect Water Soil Engine Facility	Sensor. Durabil Maintai Calibra- Inspect Inspect Water Soil Engine-	Data Ar Data Ini Reporti Access Retenti Record Cost of Water Soil Engine	Contam Fate & - Toxicity Ecologii Uncerta Subsurf Model V System Water Soil Enginee	Long 7 Risk Water Soil Engine
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Better confidence in risk prediction	x					
Enhances ability to respond to failure in final configuration	х					

NEED CODE:	ods-	rep-emsp-1.3				
NEED TITLE:	Rem	note Sensing Of Ecosystems				
PLAIN LANGUAGE:	Nee	d To Develop Improved Remote	e Sensing Of Ecosystem Indic	rators Including Vegetation.		
SCREENING QUESTIONS	1		<u>sc</u>	REENING CATEGORIES		
Pertains to site maintenance	x	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
Relates to final engineered system performance					ion	
Improves data management				gmt	ers is ce Validat	gui
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility	Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance Validation Water Soil Engineered Units	Long Term Monitoring Risk Water Soil Engineered Units Facility
Involves long term monitoring and surveillance	X	Durability Maintainat Monitoring Predictabil Inspection Inspection Water Soil Engineere Facility		Data Anal Data Inter Reporting Accessibil Retention Records N Cost of R Water Soil Engineere Facility		
Pertains to non S and T			XXXXXXXX		x	x xx
Better confidence in risk prediction						
Enhances ability to respond to failure in final configuration						

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ong-term Monitoring Of Caps And Covers
leed To Identify Improved Long-term Monitoring Of The On-Site Disposal Facility Cover System.

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SCREENING QUESTIONS																																			
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Relates to final engineered system performance	х							_												_								tion						_	
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Contributes to better understanding of fate and transport		Durability Maintainability	Monitoring Predictability	nspection Freq.	1	Soil Engineered Units	ıty	Sensor/Device	Durability Maintainability	Calibration	ig ig	Ę.	Engineered Units	ıty	Data Analysis	Data Interpretation Reporting	Accessibility	Ketention Records Mgmt	Ţ	<b>-</b>	Engineered Units	61	Contaminant Modeling	rate & Transport Toxicity	Ecological Indicators		Subsurface Issues Model Validation	em Performar	<u>.</u>	Engineered Units Facility	: : :	rerm Monitoring	<u>.</u>	Engineered Units	ity
Involves long term monitoring and surveillance	X	Dura	Moni	Inspe	Water	Soil	Facility	Sens	Main	Calib	lnsp	Water	Engi	Facility	Data	Repo	Acce	Records	Cost	Water	Engi	- 2	Cont	Toxicity	Ecole	Unce	Sans	System	Water	Engi		Risk	Water	Engi	Facil
Pertains to non S and T		Ш	X	X		X							11		Ш			<u> </u>				<b>.</b>		<u> </u>	Ш						J L				
Better confidence in risk prediction	x																																		
Enhances ability to respond to failure in final configuration	$ \Box $																																		

NEED CODE:	oh-f052
NEED TITLE:	Long-term Treatment And Monitoring Of Leachate
PLAIN LANGUAGE:	Need For A Stand-alone System To Detect And Treat Leachate After All Other Operating Systems Are Shut Down.

SCREENING QUESTIONS	l 1								<u>sc</u>	RE	ENI	ING	C/	TE	<u>GO</u>	RIE	<u>S</u>														
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NEED CODE:	ORBV	V-08				
NEED TITLE:	Long-	term Performance Assessmer	nts			
PLAIN LANGUAGE:		oved Predictive Capabilities Fo	r Long-term Performance Ass	sessments Are Needed To Ensu	re Long-	
SCREENING QUESTIONS			<u>sc</u>	CREENING CATEGORIES		
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
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Enhances ability to respond to failure in final configuration

NEED CODE:	ORHY-06
NEED TITLE:	Fractured Media Flow Characterization
PLAIN LANGUAGE:	Technologies Are Needed To Predict Fracture Networks, Groundwater Flow And Contaminant Transport Below Ground.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting
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NEED CODE:	ORHY-21				
NEED TITLE:	Real Time Performance Assessme	ent Monitoring			
PLAIN LANGUAGE:	Technologies For Real-time, In Sit	tu Monitoring Of Groundwater A	And Surface Water.		
SCREENING QUESTIONS	1 1	<u>sc</u>	CREENING CATEGORIES		
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Contributes to better understanding of fate and transport	ity ring ability dion Freq. dion Cost	/Device ity inability tion Freq. iion Cost ered Units	nalysis tterpretation ining sibility on Records Mg	rinant Modeling Transport ical Indicators ainty Analysis face Issues Validation Performance \( \)	erm Monitoring

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Better confidence in risk prediction

Enhances ability to respond to failure in final configuration

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NEED CODE:	ORH	HY-21A					
NEED TITLE:	Real	Time Performance Assessmen	nt Monitoring				
PLAIN LANGUAGE:	Tech	nologies For Real-time, In Situ	Monitoring Of Groundwater A	and Surface Water (Paducah).			
SCREENING QUESTIONS	I		<u>sc</u>	REENING CATEGORIES			
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failure in final configuration

NEED CODE:	RF-SNM18
NEED TITLE:	Core Scientific R&D Capability In Support Of NMFA Nuclear Material Management Needs
PLAIN LANGUAGE:	Need For Retention Of Scientific Expertise (chemistry And Physics) Related To Safety And Health Issues For Stabilization And Storage Of Nuclear Materials.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
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NEED CODE:	RL-DD052
NEED TITLE:	Long-term Monitoring Around And Under The 221-U Facility For CDI
PLAIN LANGUAGE:	Technologies Are Needed To Monitor Contaminants In The Soil Around And Under The 221-u Facility To Verify That Contaminants Are Being Contained Now And In The Future.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Cross Cutting
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NEED CODE:	RL-SS24-S
NEED TITLE:	Detection/distribution Of Contaminants - Chemical Binding On Site-specific Mineral Surfaces
PLAIN LANGUAGE:	Research Is Needed To Characterize The Chemical Composition Of Microbially-produced, Metal-binding Molecules.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
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Enhances ability to respond to failure in final configuration				

IEED CODE:	RL-SS25-S
IEED TITLE:	Detection/distribution Of Contaminants - Chemical Form And Mobility Of Dense, Non-aqueous Phase Liquids In Hanford Subsurface
PLAIN LANGUAGE:	Better Understanding Of Chemical Form And Mobility Of Dense, Non-aqueous Phase Liquids (DNAPL's Below Ground.

SCREENING QUESTIONS	l I						<u>sc</u>	CRE	EN	ING	CATE	GOF	RIES												
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NEED CODE:	RL-SS26-s
NEED TITLE:	Transport Of Contaminants - Reaction Rates For Key Contaminant Species And Complexes In Site-specific Groundwater
PLAIN LANGUAGE:	Determine How And How Fast Contaminants Change Chemical Form And/or Interacts With Minerals (e.g. Carbonates) In Soil.

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NEED CODE:	RL-SS27				
NEED TITLE:	Use Of Field Data From Represer Contaminant Distribution	ntative Sites To Elucidate Contr	rolling Features And Processe	s For	
PLAIN LANGUAGE:	Need To Investigate Field Sites To That Affect Contaminant Distributi Times.	•	• ,		
SCREENING QUESTIONS	1 1	<u>sc</u>	CREENING CATEGORIES		
Pertains to site maintenance	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	C
Relates to final engineered system performance				ation	

NEED CODE:	RL-SS27-s
NEED TITLE:	Transport Of Contaminants - Rate Of Coupled Abiotic And Biogeochemical Reactions Involving Contaminants In Hanford Subsurface
PLAIN LANGUAGE:	A Better Understanding Of The Chemical And Biological Interactions That Affect Contaminant Movement Below Ground.

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NEED CODE:	RL-SS28
NEED TITLE:	Understand, Quantify And Develop Descriptions Of Reactions And Interactions Between Contaminants Of Concern And Vadose Zone Sediments
PLAIN LANGUAGE:	A Better Understanding Of Why Contaminants Become More Or Less Mobile With Longer Contact Times, And The Physical, Chemical, And Biological Causes Of Such Changes And How They Are Appropriately Modeled.

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NEED CODE:	RL-SS28-s
NEED TITLE:	Transport Of Contaminants - Rates Of Colloid Formation And Colloidal Transport Of Contaminants In Site-specific Groundwater
PLAIN LANGUAGE:	Need To Determine The Mechanisms And Rates Of Production Of Inorganic And Organic Colloids In Groundwater, The Rates Of Adsorption Of Contaminants Onto Colloids, And The Effect Of Colloid-facilitated Transport On Contaminant Migration.

	SCREENING CATEGORIES				
SCREENING QUESTIONS					
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting	
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Better confidence in risk prediction	x				
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	SCREENING CATEGORIES
PLAIN LANGUAGE:	Need To Improve The Modeling Of Below Ground Contaminant Movement By Including Additional Processes (e.g. The Coupling Of Physical And Chemical Processes), With Finer Grids And Time Spacings, For Better Simulation.
NEED TITLE:	Develop Descriptions Of Contaminant Flow And Transport In The Vadose Zone
NEED CODE:	RL-SS29

SCREENING QUESTIONS															
Pertains to site maintenance		Waste Form/Physical Barriers		Data Coll Transmis			Information Management			Environme Setting	ntal		1 1	Cross Cutting	
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Better confidence in risk prediction	x														
Enhances ability to respond to failure in final configuration															

NEED CODE:	RL-SS29-s
NEED TITLE:	Transport Of Contaminants - Effect Of Subsurface Heterogeneities On Chemical Reaction And Transport
PLAIN LANGUAGE:	Need To Develop Detection Methods That Provide Adequate Signal Penetration And Reflection/refraction And Account For Sediment Moisture, Grain Size, And Clay Content. Science Is Needed To Determine Chemical Information In Situ As Well.

	SCREENING CATEGORIES																																						
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Enhances ability to respond to failure in final configuration																																							

NEED CODE:	RL-5S30
NEED TITLE:	Understand And Quantify Water Movement In The Vadose Zone Using Uncontaminated Field Sites.
PLAIN LANGUAGE:	Better Understanding Of The Nature And Extent Of Preferred Flow Paths Below Ground Along With A Determination Of Which Physical Features And Moisture Conditions Affect The Preferred Flow Paths Is Needed.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers		Cross Cutting
Relates to final engineered system performance			<u> </u>	
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Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Sensor/Device Durability Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water Soil Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \text{Validation} System Performance \text{Validation} System Performance \text{Validation} Soil Engineered Units Facility Long Term Monitoring Risk	Water Soil Engineered Units Facility
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NEED CODE:	RL-SS30-s
NEED TITLE:	Transport Of Contaminants - Remedial Technology For Cesium Beneath Waste Tanks
PLAIN LANGUAGE:	A Need For An Improved Understanding Of The Chemical Processes Affecting Cesium Transport Below Ground In Conjunction With HLW Tank Liquids.

SCREENING QUESTIONS	l 1		SCREENING CATEGORIES	
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Enhances ability to respond to failure in final configuration				

NEED CODE:	RL-SS31-s
NEED TITLE:	Remediation - Mathematical Formulations Of Chemical Reaction/material Transport
PLAIN LANGUAGE:	A Need For Better Computational Tools To Address A Wide Range Of Chemical Reactions, And Reaction
	Rates.

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Enhances ability to respond to failure in final configuration														

NEED CODE:	RL-SS32
NEED TITLE:	Understand And Quantify The Relationship Between Contaminant Sources, Vadose Zone Plume Properties And Groundwater Plume Properties At Hydrologic Boundaries With A Focus On The Groundwater-vadose
PLAIN LANGUAGE:	Better Understand The Behavior Of Contaminants At The Water Table Boundary.

	SCREENING CATEGORIES																												
SCREENING QUESTIONS																													
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Enhances ability to respond to failure in final configuration																													

NEED CODE:	RL-SS32-s
NEED TITLE:	Remediation - Reactivity Of Organics In The Hanford Subsurface
PLAIN LANGUAGE:	Better Understanding Of The Biodegradation Of Halogenated Organic Compounds And Metal/radionuclide Organic Constituents.

	SCREENING CATEGORIES																													
SCREENING QUESTIONS																										<b>-</b> -				
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Enhances ability to respond to failure in final configuration																														

NEED CODE:	RL-SS33
NEED TITLE:	Techniques To Delineate Groundwater Plumes In Three Dimensions And Define A Scientific Basis For Addressing Scaling Issues In Hanford Groundwater
PLAIN LANGUAGE:	Better Understand How To Incorporate Three-dimensional Properties Of Contaminanted Groundwater And Regional-scale Data Into Predictions Of Contaminant Concentration And Distribution.

			<u>sc</u>	REENING CATEGORIES		
SCREENING QUESTIONS						
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
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Enhances ability to respond to failure in final configuration	$ \Box $					

NEED CODE:	RL-SS33-s
NEED TITLE:	Remediation - Interaction Of Remedial Processes With Hanford Subsurface
PLAIN LANGUAGE:	Need To Measure Reaction Rates Of Contaminants Being Remediated And Those Solids, Liquids, And/or Gases Introduced As Part Of Remedial Action.

	SCREENING CATEGORIES												
SCREENING QUESTIONS													
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting							
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Better confidence in risk prediction	x												
Enhances ability to respond to failure in final configuration													

NEED CODE:	KL-5534
NEED TITLE:	Understand, Quantify And Develop Descriptions Of Biogeochemical Reactions And Interactions Between Contaminants Of Concern And Aquifer Sediments To Describe Biochemical Reactive Transport
PLAIN LANGUAGE:	A Better Understanding Is Needed Of The Chemical, Physical, And Biological Processes That Affect The Long-term Behavior Of Contaminants As They Enter The Aquifer And During Transport To The River.

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Enhances ability to respond to failure in final configuration						

NEED CODE:	RL-SS35
NEED TITLE:	Technologies To Quantify The Flux Of Contaminant From Hanford Groundwater To The Columbia River
PLAIN LANGUAGE:	Better Understanding Of How Contaminants Move To The River (shoreline, Bed Of The River, And How Far Out Into The River), And How Discharges Are Affected By Daily And Seasonal Variations Of The River Flows.

	SCREENING CATEGORIES											
SCREENING QUESTIONS												
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Contributes to better understanding of fate and transport	X	Durability  Maintainability  Monitoring  Predictability inspection Freq. Inspection Cost  Water  Soil  Engineered Units Facility	Theorice ity nability ition Cost ion Freq. ion Cost ion Cost on allysis terpretation on s. Mgmt on the cords in the cords	Risk Water Soil Engineered Units Facility								
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RL-SS35-S
Monitoring Of Contaminants - Use Of Chemical Surrogates For Contaminants
Need To Identify An Easy-to-measure Substitute Chemical As An Estimator For A Hard-to-measure Contaminant.

	SCREENING CATEGORIES																											
SCREENING QUESTIONS																												
Pertains to site maintenance		Waste Form/Physical Barriers		Data Trans									ation emer	- 1					viror	nmei	ntal					Cro	ss	
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Better confidence in risk prediction	х																											
Enhances ability to respond to failure in final configuration																												

NEED CODE:	RL-SS36
NEED TITLE:	Provide Means To Integrate Regional-scale Phenomena Into Assessments Of Contaminant Transport And Impacts Within The Columbia River.
PLAIN LANGUAGE:	A Need To Model And Understand Regional Effects Of Chemical And Physical Components On Contaminant Movement To River Systems.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission  Information Management  Environmental Setting	Cross Cutting
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Contributes to better understanding of fate and transport	x	Durability Maintrainability Monitoring Predictability Inspection Freq. Inspection Cost Mater Soil Engineered Units Facility	wice wice wice wice with a Unit was and Month in Sport in	Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	RL-SS37
NEED TITLE:	Provide Methodology To Relate Information Derived From Sitewide-scale Groundwater Flow Modeling To The Various Scales Associated With Assessing Impacts In The River Environment
PLAIN LANGUAGE:	A Need To Develop Transport Models To Quantify The Changes In Groundwater Characteristics, Flow Path, And Mathematical Computations For Estimating Contaminant Concentrations In The River.

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Enhances ability to respond to failure in final configuration																										

NEED CODE:	RL-SS37-S
NEED TITLE:	Monitoring Of Contaminants - Chemical Sensor Principles
PLAIN LANGUAGE:	A Better Understanding Of The Physics And Chemistry That Will Lead To More Accurate And More Sensitive Measurements Of Contaminant Concentrations.

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Enhances ability to respond to failure in final configuration																														

NEED CODE:	RL-SS38
NEED TITLE:	Understand, Quantify And Develop Descriptions Of Transport And Transformation Of Groundwater-derived Contaminants Of Concern In The River
PLAIN LANGUAGE:	Develop A System (techniques/equipment/instrumentation) To Measure Chemical, Physical, And Biological Parameters In The Area Between The Aquifer And The River, And To Validate And Verify Models.

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Better confidence in risk prediction	х																											
Enhances ability to respond to failure in final configuration																												

NEED CODE:	RL-SS39
NEED TITLE:	Understand And Provide Means To Quantify The Impacts Of River Contamination On Receptors
PLAIN LANGUAGE:	Need To Develop Consistent Ways To Measure Impacts (human, Ecological, Cultural, Socioeconomic) To Exposed Groups.  Information Will Be Used To Determine Toxicity Benchmarks For

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Enhances ability to respond to failure in final configuration																						

NEED CODE:	RL-SS40
NEED TITLE:	Provide A Method To Develop Mass Balance (i.e., Holistic) Inventory Estimates
PLAIN LANGUAGE:	There Is A Need For A Single And Consistent Inventory Of The Discharges And Disposals Of Radionuclides And Chemicals To The Surface And Subsurface.

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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	RL-SS41
NEED TITLE:	Understand And Quantify The Solubility Of Contaminants Of Concern At The Waste-Vadose Zone Sediment Interface
PLAIN LANGUAGE:	A Better Understanding Of Solubility Of Certain Contaminants In Various Waste Matrices (e.g., Tc In Tank Waste) And How This Solubility Changes As The Waste Interacts With The Below Ground Sediments.

			SCREENING CATEGORIES	
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	RL-WT017
NEED TITLE:	Long-term Testing Of Surface Barrier
PLAIN LANGUAGE:	There Is A Need For Better Understanding Of Long-term Performance Of Surface Barriers To Reduce Moisture Infiltration And Plant And Animal Intrusion.

SCREENING QUESTIONS	l	ı															<u>sc</u>	RE	EEI	ΝIΛ	IG	<u>CA</u>	TE	<u>GO</u>	RIE	<u>S</u>															
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Better confidence in risk prediction																																									
Enhances ability to respond to failure in final configuration																																									

NEED CODE:	RL-WT029
NEED TITLE:	Data And Tools For Performance Assessments
PLAIN LANGUAGE:	A Need For Better Estimates Of Water Movement Through Buried Waste Over Long Periods In Arid Environments To Reduce Uncertainty Of Models.

		<u>sc</u>	REENING CATEGORIES		
	Waste Form/Physical Barriers	Data Collection/ Transmission	Information Management	Environmental Setting	Cross Cutting
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IEED CODE:	RL-W1035-5
IEED TITLE:	Moisture Flow And Contaminant Transport In Arid Conditions
PLAIN LANGUAGE:	A Better Understanding Of The Soil Physics And Retardation Of Contaminants In Soils Under Natural Conditions Is Needed For Dose Calculations.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers	ata Collection/ Information Environmental ansmission Management Setting	Cross Cutting
Relates to final engineered system performance			uoi	
Improves data management			gmt ling s s	ing
Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Cost Water Soil Engineered Units Facility	Maintainability Calibration Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Records Interpretation Records Mgmt Cost of Records Mgmt Soil Eroligian Contaminant Modeling Fate & Transport Traxicity Contaminant Modeling Soil Subsurface Issues Model Validation System Performance V Water	Soil Engineered Units Facility Long Term Monitoring Risk Water Soil Engineered Units Facility
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Surveillance	l l			
Pertains to non S and T				
Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	RL-WT043-S
NEED TITLE:	Effect Of Human And Natural Influences On Long-term Water Distribution
PLAIN LANGUAGE:	A Need To Better Understand Long Term Land And Water Use At DOE Sites Considering Climate Change And The Ability To Incorporate Impacts Of Those Changes Into Models To Predict The Movement Of Contaminants.
	SCREENING CATEGORIES
SCREENING QUESTIONS	
Pertains to site maintenance	Waste Form/Physical Barriers Data Collection/ Transmission Information Management Environmental Setting Cross Cutting
Relates to final engineered system performance	
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Contributes to better understanding of fate and transport	Durability Maintainability Maintainability Maintainability Inspection Cost Water Soil Engineered Units Facility Maintainability Maintainability Calibration Inspection Freq. Inspection Freq. Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Analysis Data Analysis Data Analysis Data Interpretation Records Mgmt Accessibility Retention Records Mgmt Cost of Records Mgmt Cost of Records Mgmt Cost of Records Mgmt Cost of Records Mgmt Contaminant Modeling Facility Contaminant Modeling Facility Contaminant Modeling Expection Soil Engineered Units Facility Long Term Monitoring Risk Water Soil Engineered Units Facility Contaminant Modeling Facility Facility Contaminant Modeling Facility
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Better confidence in risk prediction

Enhances ability to respond to failure in final configuration

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NEED CODE:	RL-WT044-S
NEED TITLE:	Distribution Of Recharge Rates
PLAIN LANGUAGE:	A Need To Quantify Distribution Of Recharge Water Through The Waste Site And The Time Delay Through The Land Surface Into The Water Table.

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SCREENING QUESTIONS																									_				
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Relates to final engineered system performance																						ion							
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Surveillance	l l				П												Х			$\Box$	(X	Х	$\Box$			${\mathbb T}$	П	T	П
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Better confidence in risk prediction	х																												
Enhances ability to respond to failure in final configuration																													

NEED CODE:	RL-WT045-S
NEED TITLE:	Vadose Zone Flow Simulation Tool Under Arid Conditions
PLAIN LANGUAGE:	Develop A Simulation Model To Predict The Movement Of Contaminants Over Long Periods Of Time In Aric Conditions.

SCREENING QUESTIONS	l I		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management Environmental Setting	Cross Cutting
Relates to final engineered system performance			ation	
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Pertains to non S and T			]	
Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	SR00-1026
NEED TITLE:	Reduce The Conservatism And Technical Uncertainty Associated With The Use Of Literature Coefficients (Kd) To Describe Radionuclide Sorption To Sediments In Performance Assessment Modeling.
PLAIN LANGUAGE:	There Is A Need To Develop Alternative Concepts For Describing Contaminant Separation Beneath Radioactive Waste Disposal Facilities.

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SCREENING QUESTIONS																														_			
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Relates to final engineered system performance																											_ uoi						_
Improves data management																			Mgmt			Scila	p E	က္ည	. <u>s</u>		ce Validation			pui.	)		
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Better confidence in risk prediction	x																																
Enhances ability to respond to failure in final configuration																																	

NEED CODE:	SR00-1030
NEED TITLE:	Model Degradation In Cement Based Wasteform (e.g., Saltstone) And Concrete Vault Degradation And Collapse
PLAIN LANGUAGE:	There Is A Need To Develop A Model To Simulate The Degradation Of Saltstone, A Cement-based Wasteform, And The Concrete Vaults Into Which It Is Emplaced Over Time Periods Of Thousands Of Years.

SCREENING OFFICIAL	SCREENING CATEGORIES										
SCREENING QUESTIONS											
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Relates to final engineered system performance	x			ition							
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Contributes to better understanding of fate and transport	X	Durability Maintainability Monitoring Predictability Inspection Freq. Inspection Cost Water Soil Engineered Units Facility	Inspection Cost Water Soil Engineered Units Facility Data Analysis Data Interpretation Reporting Accessibility Retention Records Mgmt Cost of Records Mgmt Water	Engineered Units Facility Contaminant Modeling Fate & Transport Toxicity Ecological Indicators Uncertainty Analysis Subsurface Issues Model Validation System Performance \text{Vastem} Water Soil Engineered Units Facility Water Soil Engineered Units Facility Facility Facility Facility Facility Facility Facility Facility							
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Better confidence in risk prediction	x										
Enhances ability to respond to failure in final configuration											

NEED CODE:	SR00-3027
NEED TITLE:	Long Term Monitoring Technologies
PLAIN LANGUAGE:	Need To Develop Insitu Remote Monitoring Technologies To Reduce The Cost Of Data Collection Associated With Waste Sites.

			SCREENING CATEGORIES	
SCREENING QUESTIONS				
Pertains to site maintenance		Waste Form/Physical Barriers		Cross Cutting
Relates to final engineered system performance	х		gigo	
Improves data management			Mgmt Mgmt deling trors yesis as ance Validation soring	
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Better confidence in risk prediction	x			
Enhances ability to respond to failure in final configuration				

NEED CODE:	SR00-4010
NEED TITLE:	Characterization Data Management
PLAIN LANGUAGE:	Need To Develop A Relational Database To Allow Storage And Retrieval Of Comprehensive Data, Including
	Photos And Videos Related A D&D Project.

SCREENING QUESTIONS	I I		SCREENING CATEGORIES	
Pertains to site maintenance		Waste Form/Physical Barriers	Data Collection/ Transmission Information Management Environmental Setting	Cross Cutting
Relates to final engineered system performance			ition	
Improves data management	x		gmt ling rs is	ū
Contributes to better understanding of fate and transport		Durability Maintainability Monitoring Predictability Inspection Freq. Nater Soil Engineered Units		Long Term Monitoring Risk Water Soil Engineered Units Facility
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Better confidence in risk prediction				
Enhances ability to respond to failure in final configuration				